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The first issue of				1888 cont'ined		175	different adv'ts.
1881 contained		28	different adv'ts.	1889	"	234	" "
1882	"	45	" "	1890	"	289	" "
1883	"	63	" "	1891	"	325	" "
1884	"	82	" "	1892	"	316	" "
1885	"	100	" "	1893	"	317	" "
1886	"	138	" "				
1887	"	154	" "				

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Synchronous Motors. THOSE who are at present engaged in developing synchronous motors will be interested in the recent experiments of Mr. Mordey, abstracted in our Digest this week, in which he calls attention to the importance of the exciting current and its effect on the power factor. The results are very satisfactory, showing that the power factor can be maintained very high by simply choosing the proper exciting current.

Welding by Means of the Arc. USING the electric arc for welding purposes has held a very insignificant place in comparison with Thomson's well-known method, but from an abstract in the Digest this week it will be seen that by using several arcs and keeping them in motion over the surface to be welded very good commercial results are being obtained. Such a method is futhermore applicable to cases in which neither Thomson's method nor the one commonly used by blacksmiths are available.

Non-Synchronous Motors. THE discussion which is at present going on in regard to the invention of the non-synchronous motor of to-day, may be summed up by saying that it was an American invention, which was subsequently developed abroad into a commercial motor; the relatively high frequency used in this country seems to be to blame for its slow development on this side of the Atlantic. A cheap "frequency reducer," if such a thing is practicable, would probably soon develop the invention of such motors in this country also.

The Renewal of Incandescent Lamps. THE question has often been raised, would the renewal of broken or worn out incandescent lamps be an infringement of the Edison patent? There are many who have held that it would not. There are those, too, who hold that it would be; and the question is one that, in view of the past decisions in favor of the validity of the broad patent awarded to Edison, must soon attract the attention of the courts. Every now and then some manufacturer or firm announces that it is preparing to go into the business of renewing such lamps, and the economy of such renewal has been argued *pro* and *con* for some time past. Those who are contemplating such a business will want to know just how they stand in law before they invest very largely of their capital, and it seems not improbable that they themselves will bring the matter up so as to have it settled one way or another without waiting for those to act who believe that their rights have been infringed. Mr. A. B. Upham presents his views of the case in this issue and upholds them by reference to what he considers parallel cases which have already been adjudicated.

The Cost of Steam Power. THE paper read by Dr. Chas. E. Emery before the American Institute of Electrical Engineers on Tuesday, March 21, is a revision of one by the same author read originally before the American Society of Civil Engineers in November, 1883, and which at the time attracted wide attention. In bringing the present paper up to date Dr. Emery found singularly few discrepancies to be filled in. Careful students of steam engineering were, of course, aware of the inevitable conclusions reached by the author through his careful analysis of the factors entering into the ultimate cost of steam under various conditions, but too great publicity cannot be given to these for the good of the cause, for it is the education of the masses rather than of individuals by which progress is measured. The conclusion that the cheaper engines of simple construction, although not securing the maximum economy of fuel, are, under the conditions usually prevalent in cities and towns along established lines of communication, the greatest dividend payers, is startling and will be a revelation to many supposedly well-informed people, but Dr. Emery's analysis points inevitably to that conclusion and shows just why and how this is so. The paper is a lengthy one, and read before the Institute only in abstract, but it may be found in full in the Transactions of the American Institute of Electrical Engineers for March, and is well worthy of careful perusal and study. Elsewhere we give a brief abstract, which, however, cannot do the subject justice. The present paper was originally read as a lecture before the students in engineering at Sibley College, Jan. 20, 1893.

The Proper Use of Terms. WE print this week some remarks of Prof. W. E. Ayrton in a recent discussion before the Institution of Electrical Engineers on Dr. Fleming's paper, in which he takes the stand of making our terms more specific by the use of abbreviations which will admit of no misconstruction. It is true that there has been considerable confusion as to the real meaning of many of the terms peculiar to literature on the alternating current, among which Prof. Ayrton selects "virtual current" and "effective current" as examples, for which he would substitute "M. S. current" and "R. M. S. current," meaning the mean square and the square root of the mean square of the current, in order to specify which, under the circumstances, was meant. As our knowledge of alternating current phenomena becomes more specific, it is but natural that the more general terms, although adopted by the highest authority in the earlier development of this branch of electrics, should have outgrown their usefulness. As it seems not unlikely that many questions of this kind will be brought before the Electrical Congress at the World's Fair, Prof. Ayrton's suggestion is opportune and is in line with the desire of those most interested in the success of the coming Electrical Congress, that all suggestions that are likely to be brought up be fully discussed in the technical journals and elsewhere before their authoritative consideration by that body is taken up. We hope the example set by Prof. Ayrton will be liberally followed, and we reiterate our invitation to those who have the interests of the convention at heart to make free use of our columns for that purpose.

Commercial Phosphorescent Lights. WE are pleased to see that the long-prophesied and much-talked-of "cold light" which is to revolutionize modern lighting appears now to have been promoted from the rank of a laboratory apparatus to that of a lamp for commercial lighting. As will be seen from a note in our Digest this week, an enterprising firm in England is making a good beginning by introducing commercial lamps in which the light is produced by high tension discharges in phosphorescent vacuum tubes. Although, as with most inventions of a radically new type, there are still very serious objections to it, yet these are being overcome, one by one, and it is not unlikely that this beginning will encourage others to take up the field. The subject is of special interest just now, owing to the unsatisfactory state of the incandescent lamp question. As there are no fundamental patents to hinder the developing of such lamps, inventors need not fear being handicapped by some future legal decision. Attention might here be called to the recent paper of Dr. Sumpner on diffusion of light, published in these columns, from which it will be seen that an effective illumination does not depend alone on the brightness of the lamps, but that if the light is diffused, a much smaller candle power will produce practically the same illumination. Phosphorescent light, in its very nature, is a diffused light, and the actual candle power of such lamps is therefore not the only feature to be considered. To properly compare the cost of the diffused light from such lamps with that from incandescent lamps, an experiment should be made by lighting the same room, first with one kind and then with the other, noting the different effects, entirely independently of the candle power of either of the lamps; from such an eminently practical test the relative costs could then be deduced. Even the most practical man could not object to such a test.

The Lamp Situation. THE second installment of views on the lamp situation is given this week. The questions recently suggested are discussed from four different standpoints—that of a consumer who operates his own extensive isolated plant; that of an electrical engineer and contractor whose business it is to put in such plants; that of the General Electric Company, and finally and briefly, that of the electrical supply dealer. What is said by Mr. Fish as representing the General Electric Company is of the most importance from the fact that it may be said to be the first authoritative utterance that that company has made since the recent lamp suits have given the subject such prominence. While Mr. Fish leaves no doubt as to the immediate policy of his company toward alleged infringers, he frankly admits that it has no policy for the future and cannot have until the present cases are disposed of, except to enforce its rights to the Edison patent as defined by the court. This will be a disappointment to many who had hoped to have heard outlined before this the exact intentions of the General Electric, and thus to have settled the uncertainty for the future. The communication from one well competent to speak for the large consumer, using lights from his own isolated plant, presents somewhat forcibly the gravity of the situation in which he finds himself, by reason of a communication he recently received, by registered mail, from the local licensees under the Edison lamp patent. The other views will also be read with interest. How exceedingly non-committal those who have thus far given their views on this subject are must be generally remarked. Several who thought their business would be injured as a result of the lamp decisions gave it as their opinion that electrical journals like THE ELECTRICAL WORLD should speak very frankly to the General Electric Company and point out to it the course it was expected to pursue in this matter. When the suggestion of discussing the subject in THE ELECTRICAL WORLD was made, each of these was invited by letter to give his views, either over his own signature or otherwise, and, strange as it may seem, not one of them responded, except to the effect that he had nothing to say for publication. The problem before the General Electric Company is more complicated and more difficult than either the general or the electrical public appreciate, and possibly in the end the interests of the electrical business will be best served by letting matters take their own course, at least until it is seen that those interests are really in danger. Should that time ever come it will certainly bring with it its own remedy. If the present form of incandescent lamp shall become sufficient of a monopoly to interfere with the growth and progress of the electrical business there will certainly arise a new lamp that will not infringe the Edison patents Perhaps it is this thought that makes most electricians inclined to look at the matter so complacently, or it may be that the fact is becoming more generally known that several companies are already working upon such lamps, and with what promises to be gratifying success. The Edison lamp is by no means the best in the world. Who knows but that the new lamp, when it comes, may be such that we shall all say that the recent decisions and the present temporary uncertainty have been blessings in disguise.

Important Decision of the Supreme Court.

The Supreme Court of the United States, on Monday, March 27, rendered an important decision in the case of Henry Huber et al. vs. the Nelson Manufacturing Company, which is destined to have a practical bearing upon the telephone situation. The court decided that a foreign patent, having lapsed by reason of non-payment of stamp duty, an American patent granted for the same invention is void. According to high officials in the Patent Office this destroys Edison's quadruplex telephone patent, as well as his three microphone patents, leaving the Bell Telephone Company after January next to rest its claims for the control of the telephone business solely upon the Berliner patent. The opinion was delivered by Justice Blatchford, who called attention to a decision of the Supreme Court on March 24, 1890, in which it was held that a United States patent ran for the term for which the prior foreign patent was granted, without reference to whether the latter patent became lapsed or forfeited after the grant of the United States patent, by reason of the failure of the patentee to comply with the requirements of the foreign patent law. But that case, however, did not distinctly cover the present one, because in that case the foreign patent was in force when the United States patent was granted.

Mr. Thos. A. Edison stated in reference to the matter that he believed the American patent on the quadruplex had already expired, and expressed the following opinions in reference to patents and patent law:

"The man who framed the law making American patents expire when the prior foreign patents expire was an Andesian, a Himalayan jackass. I've never made any money on any patents, except in England. It is supposed that the patent laws were made for the benefit of inventors, but there is not one inventor in a thousand that has any interest in the final decision of the courts. I was perfectly indifferent to the decision in the incandescent lamp case. If it was the practice of the courts to let the inventor have the delay, and not the pirates, he would get some recompense for his time and labor. American inventors are afraid to apply for patents abroad because the lapse of time in granting a patent by our Government is so great that when they do finally grant it the foreign patent has expired, and, under the law, the American patent expires with it. If an inventor happens to put something on the market that is of real worth, and the pirate sees it, the first thing the inventor knows he has a powerful rival, which threatens to engulf him at the start. The pirate claims the invention, so does the real inventor, but it is the latter who has to prove his right, and as it takes a long while to even prepare his case he is disheartened from the beginning. The capitalists draw on the inventor's share in the invention to pay the expenses of the litigation, and as all the odds are against him, the inventor has little chance. There are thousands of bright men in this country to-day who are simply squelched because of this absurd law."

Richard N. Dyer, of counsel for the Edison interests, in reference to the Bell Telephone Company's patents said:

"There is only one point left, and that the Supreme Court is expected to decide early next term. It is whether the prior foreign patent which limits the United States patent should be prior to the date of issue of the United States patent or prior to the filing of the application. The former was the generally accepted view, until it was cast in doubt by recent decisions of the Supreme Court. Should the Supreme Court decide that the foreign patent must be granted prior to the application for the United States patent, the various Edison patents referred to in the dispatch and many other patents will become entirely independent of the foreign patents, and will run for full terms of 17 years.

"This, in case of the Edison patents of carbon telephone transmitters, which were granted as recently as 1891, will make those patents extend to 1908, and if the court should sustain them these patents will give the Bell Telephone Company the monopoly of the carbon telephone transmitters until that date."

An Electric Car Trial.

BY FREDERICK BEDELL.

The severe demands made upon the electric car motor, and the sudden fluctuations in the flow of current, and in the power developed, have been frequently discussed, and have often been illustrated by curves showing the performance of the car motors. The accompanying curves show the results of a trial made in Rochester by Mr. J. L. Hall and the writer, and is given as further evidence of the severe character of the service.

The car was tested under normal working conditions while making a regular passenger trip in the middle of an afternoon when the track was in good condition. The passengers in the car kept changing from 4 to 24, averaging about 12. The test was made upon a vestibuled car, built by the Gilbert Company, of Troy, N. Y., having a length of body of 18 feet and a wheel base of 6.5 feet. It had two 15-h. p. Short double-reduction motors, with 6-inch gears on the armature and intermediate shafts, made quite noiseless by wooden webs. The reduction ratio is 1 to 10.4. The current passes from the trolley to a hood switch at each end of the car, then through a fuse box to the rheostat, which has 13 sections, with a total resistance of 13 ohms, and is cut out a large part of the time. From the rheostat the current divides to the two motors, passing first through the armatures, then through the fields and to the ground. The total weight of the car was 16,120 pounds.

During the run the total current supplied the car was measured by a Weston ammeter, and the potential difference at the motor by a Weston voltmeter, the instruments being simultaneously read every five seconds and the results recorded. The advantages obtained by reading from these instruments in this way rather than employing self-recording instruments are two: First, the aluminium needle and the suspension in these instruments are lighter and their accuracy is accordingly less affected by the inertia of the moving parts. Second, in calculating the horse power from the results, it is necessary to integrate the curve for current and potential, which may be done by this method by averaging the five-second readings; whereas, in case a self-registering device is employed, the curves must be gone over with a planimeter, and experience shows that the integration of the blurred and confused curves which result is far from satisfactory. On the other hand, the curves thus obtained from five-second readings lose none of the minor variations. However, that the mean final result is not materially affected thereby is seen when we consider that in an hour's run the horse power is calculated from a mean of 1,440 readings.

The accompanying curves speak for themselves. The upper curve shows the potential supplied to the motors; the lower curve, the total current taken; the middle curve, the electrical horse power averaged for half-minute intervals. The location of feeders is indicated by circles. The five curves in the route are as follows, the radius being measured to the centre of the track:

No. of curve	I.	II.	III.	IV.	V.
Length	90°	90°	40°	103°	90°
Radius, ft	59.5	50	90	40	80

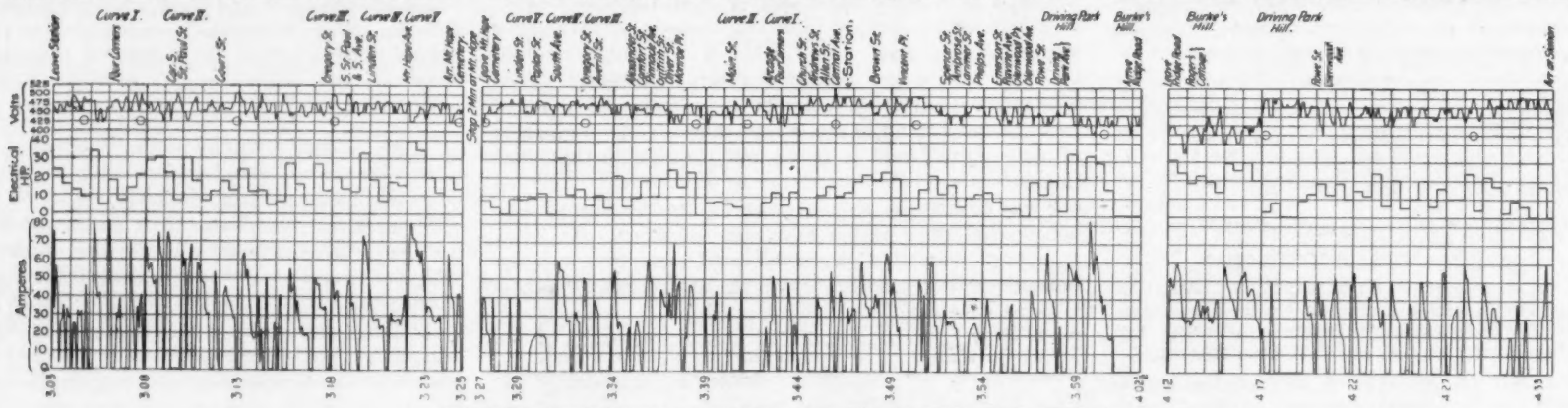
In general the route is quite free from grades, the heaviest being a grade of 4 per cent. at Burke's Hill.

Some of the results of the test are as follows:

	Amperes. Mean.	Amperes. Maximum.	Electrical horse power. Mean.	Electrical horse power. Maximum. Momentary.	Electrical horse power. Maximum. For ½ min.
Station to Mt Hope	28.06	81	17.3	50	40
Mt. Hope to station	15.41	70	9.5	43.2	31
Station to Ridge Rd	21.19	82	13.1	50.7	34
Ridge Rd. to station	22.36	60	13.8	37.1	31
Average	21.94	..	13.5	....	

By an independent run the tractive force on a level road was found to be about 1.9 per cent. of the weight of the car.

The above results and curves clearly illustrate the character of the demands of electric traction under normal working conditions.



CURVES SHOWING RESULTS OF ELECTRIC CAR TRIAL.

Telegraphers' Tournament.

A tournament under the auspices of the Telegraphers' Mutual Relief Association was held at Hardman Hall, New York, on Saturday, March 25, at which a number of prizes were offered for the most proficient in the various branches of the telegraphic art. In sending, in the ladies' class, 500 words was the task, the first prize being $50 and the second $25. In receiving, the first prize was $25 and the second $15.

In the sending class, Mrs. E. Sandberg, of the Postal Telegraph Company, completed the task in 11 minutes 13 1-5 seconds, her rate being 44½ words per minute. Miss Louise Wagner completed the same task in 13 minutes 12 seconds, or at the rate of 39½ words per minute.

The greatest interest for the day centered in the message receivers' contest for the gold medals offered by John W. Mackay. The value of the first prize medal was $150; that of the second, $100.

The contestants were: J. F. Parks, V. J. Benishler, Thos. F. Kehoe, E. A. Coney, F. M. Jones, J. Maguire, P. J. Faulkner and J. Martyn, of New York; J. H. Jones, of San Francisco; B. S. Durkee, of Portland; E. J. Thompson, of Norwich; A. Work, of Newburgh, and E. P. Porter,

William Gibson, one of the fastest senders in the country, set the pace and accomplished the remarkable task of sending 97 messages in one hour, breaking all existing records. The returns made by the receivers were handed in for comparison, the decisions being reserved for the present.

The next event was the contest for a prize given by the Caligraph company for receivers, also open to all senders who had sent more than 235 words in five minutes in a previous tournament. The first prize was $100; the second, $75. The receiving prizes were the same. The result of the latter competition was also held for announcement.

The result of the senders' competition was as follows—five minutes' work being allowed for each contestant:

E. D. Moore	242	words; 2	errors.
C. W. White	248	" 7	"
Frank English	230	" 6	"
O. Hart	243	" 10	"
J. D. Hinnaut	236	" 6	"
H. S. Rady	210	" 10	"
R. C. McCready	242	" 7	"
P. J. Faulkner	229	" 6	"

First prize was awarded to E. D. Moore for clearness and speed combined, and R. C. McCready took second. J. D. Hinnaut stood third.

The first event of the evening was the contest for the prizes offered by the Smith Premier Typewriter Company open to all except those who had sent more than 230 words in five minutes in a previous tournament. First prize for both senders and receivers, $100; second prize, $75.

Senders:			
R. C. McCready	242½	words; 5	errors
Wm. Khtz	195	" 0	"
O. Hart	246	" 6	"
J. D. Hinnaut	238	" 3	"
E. D. Moore	234	" 0	"
F. English	239	" 5	"
John Masterson	201	" 3	"
F. W. Robinson	213	" 11	"

The decisions in both sending and receiving classes were reserved.

The judges were: J. H. Emerick, General Manager Postal Telegraph Company; George H. Dickinson, Boston Globe; M. M. Davis, Electrician Postal Telegraph Company; A. T. Barberie, Electrical Engineer; A. T. Baer; R. W. Martin, Night Manager United Press; A. F. Slowey, Chief Operator United Press.

Moonlight Table for April, 1893.

Herewith we give Mr. H. W. Frund's table of lighti g hours for the month of April, under his modified form of moonlight schedule:

TABLE NO. 1. Standard Moonlight. Philadelphia System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting
1	No light.	1	No light.	1	6:50 P. M.	1	12:00 M.
2	6:50 P. M.	2	9:00 P. M.	2	6:50	2	12:00
3	7:00	3	10:00	3	7:00	3	12:00
4	7:00	4	11:00	4	7:00	4	12:00
5	7:00	5	12:00	5	7:00	5	12:00
6	7:00	7	1:00 A. M.	6	7:00	7	1:00 A.M.
7	7:00	8	2:00	7	7:00	8	2:00
8	7:00	9	2:50	8	7:00	9	2:50
9	7:10	10	3:40	9	7:10	10	3:40
10	7:10	11	4:10	10	7:10	11	4:10
11	7:10	12	4:30	11	7:10	12	4:30
12	7:10	13	4:30	12	7:10	13	4:30
13	7:10	14	4:30	13	7:10	14	4:30
14	7:10	15	4:30	14	7:10	15	4:30
15	7:10	16	4:20	15	7:10	16	4:20
16	7:10	17	4:20	16	7:10	17	4:20
17	7:20	18	4:20	17	7:20	18	4:20
18	8:40	19	4:20	18	7:20	19	4:20
19	10:00	20	4:20	19	7:20	20	4:20
20	11:10	21	4:10	20	7:20	21	4:10
21				21	7:20	22	4:10
22	12:00 A. M.	22	4:10	22	7:20	22	12:00 M.
23	12:50	23	4:10	23	12:50 A M.	23	4:10 A.M.
24	1:30	24	4:10	23	7:20 P. M	23	12:00 M.
25	2:00	25	4:10	24	1:30 A. M.	24	4:10 A.M.
26	2:20	26	4:10	24	7:20 P. M.	24	12:00 M.
27	2:40	27	4:10	25	2:00 A. M.	25	4:10 A.M.
28	3:00	28	4:10	25	7:30 P. M.	25	12:00 M.
29	No light.	29	No light.	26	2:20 A M.	26	4:10 A.M.
30	No light.	30	No light.	26	7:30 P. M.	26	12:00 M.
				27	7:30	27	12:00
				28	7:30	28	12:00
				29	7:30	29	12:00
				30	7:30	30	12:00
Total hours lighting, 153.10.				Total hours lighting 210.03.			

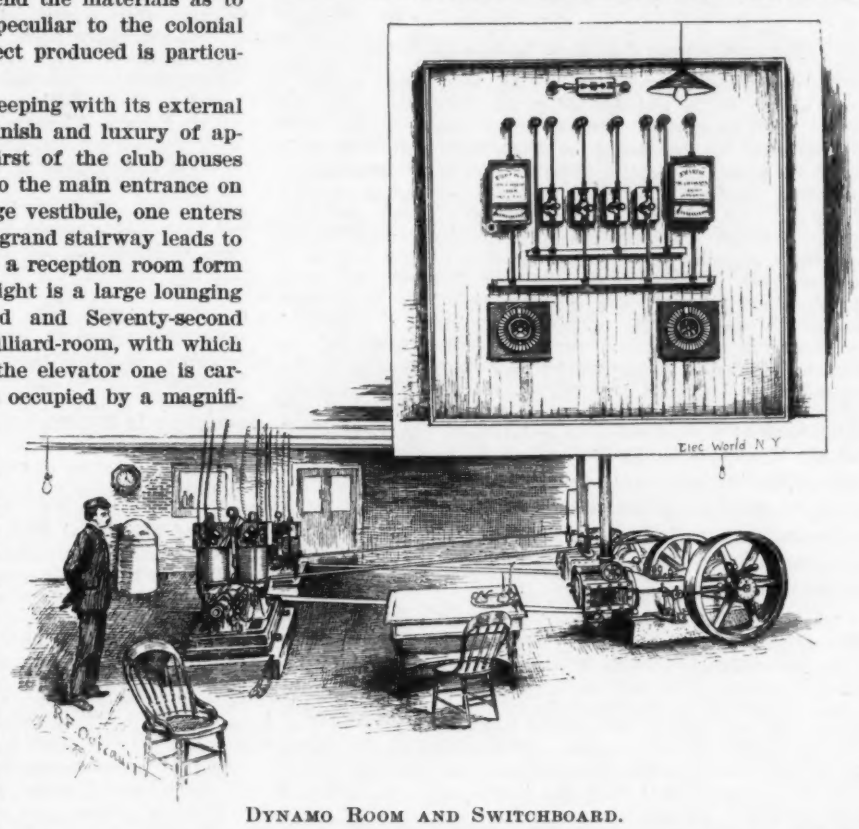
Electricity in a Modern Club.

THE Colonial Clubhouse, standing at the corner of Seventy-second street and the Boulevard, New York City, towers above its smaller neighbors, and is by far the most conspicuous building in that section. It at once attracts the attention of the passer-by, at night by the flood of light which streams from its many windows, by day by the beauty of its architecture. Every advantage has been taken of the favorable location and the graceful design and harmony of color which the style of architecture, typified in the name of the club, offers. While the structure is imposing, it does not impress one with its massiveness, as is often the case with those more severe styles of architecture frequently found in buildings of this character. The stone used is the Bedford, (Ind.), limestone. Above the first floor pale yellow brick and grayish white terra-cotta trimmings are employed, the top story being entirely of terra-cotta finished in a rich balustrade of the same material. It has been the aim of the designer to so blend the materials as to conserve the harmony of color peculiar to the colonial type of architecture, and the effect produced is particularly pleasing.

The interior of the house is in keeping with its external appearance, and in elegance of finish and luxury of appointment it ranks among the first of the club houses of the United States. Passing into the main entrance on the Boulevard and through a large vestibule, one enters the spacious hall, from which the grand stairway leads to the upper stories. The office and a reception room form a part of this hall, while to the right is a large lounging room overlooking the Boulevard and Seventy-second street. To the left leads off the billiard-room, with which is connected the cafe. Entering the elevator one is carried to the second story, which is occupied by a magnificent ball-room. This being a mezzanine story the architect was able to introduce a gallery for spectators, as well as a musician's balcony. On the same floor is a library, together with card and cloak rooms, committee rooms, etc. In the second mazzanine story are the kitchen, pantries, storerooms, servants' bedrooms and bed chambers for members. On the floor above are the main dining rooms, consisting of one large room, 38 feet long by 32 feet wide, and a number of smaller dining rooms, which can be thrown together if necessary, in all accommodations for about 300 people. The basement contains four bowling alleys, wine cellars, etc., while in the sub-basement is located the electric light, the refrigerating, heating and ventilating plants.

One of the most interesting features of this magnificent club is the part electricity plays in contributing to the convenience and comfort of its members. Not only does this faithful servant furnish soft and pleasing light in abundance, but it is also placed in charge of the heating and ventilating system, in addition to its common duties of operating a ticker, telephone, an annunciator system, and other conveniences so essential to a large establishment of this kind.

The generating plant, which, as stated above, is located in the sub-basement, is a good illustration of a well constructed and skillfully operated modern isolated plant. Steam is furnished by three 4×13 horizontal tubular boilers. The electrical equipment consists of two 25-kw. Edison dynamos, each driven by a 50-h. p. Ball engine. These machines have a normal capacity of 450 16-c. p. lights, but for ordinary duty but one of them is run, furnishing current for between 300 and 400 lights, a part of which, however, are of 24 c. p. When the ball-room is illuminated, or for any special reason the whole Club is thrown open, the services of both machines are required. One of the accompanying illustrations well represents a portion of the dynamo-room, showing the engines and generators, and giving a detail view of the switchboard. This plant has given the best of satisfaction and affords abundant light throughout the building. The disposition of the lights over the building so as to secure the most efficient illumination, and at the same time the most highly artistic effects, has been skillfully carried out. The general plan has been to distribute the lights as effectively as possible, using individual lamps or small clusters in preference to the more pretentious electroliers. The fixtures are of dainty and graceful design, and in complete harmony with the decorations and furnishings of their respective rooms.



DYNAMO ROOM AND SWITCHBOARD.

The lounging room on the first floor is lighted by a small chandelier and a series of individual 24-c. p. lights arranged around the ceiling. Lamps of 16 c. p. were first employed here, but the illumination was found to be insufficient.

In the billiard room, in addition to a chandelier of unique design and small clusters of lights upon the walls, arrangements are made for the placing of a powerful light directly over the tables. The halls and stairways throughout the building are well lighted by small groups of lights placed at advantageous points.

It is in the ballroom, however, that the most brilliant lighting effects are to be sought. This room is 66 feet in length, 32 feet wide and the ceiling is about 25 feet above the floor. A small stage, with dressing rooms to the rear, is provided for dramatic or theatrical performances. The ballroom is exquisitely decorated in white and gold, and fitted with superb hangings. The arrangement of the lights is made to harmonize with the beautiful surroundings. Six elaborate electroliers are suspended from the ceiling in two rows down the centre of the room, each containing nine lights, three bunched in a pear-shaped globe at the bottom of the chandelier and six forming a circle around it. In addition to these there are two rows of small clusters, artistically suspended, extending around the room, one near the ceiling and the other midway between that and the floor. About 124 lights are required, and when they are all turned on the effect is most brilliant.

The dining rooms are also most tastefully lighted, in the neighborhood of 134 lights being used for this purpose. In the main room a central electrolier of 24 lights and eight three-light clusters on the walls constitute the method used there with very pleasing results.

The use of electrical apparatus in connection with the heating and ventilating systems is an important application of electricity, which is gradually coming to be recognized as most essential to the equipment of the modern establishment. For this purpose electricity is more accurate and more reliable in every way than the best of human employes.

Both the direct and indirect systems of heat are used. The entire heating plant is arranged to be fed both with live steam from the boiler and with exhaust steam. The indirect system, however, has been found amply sufficient to maintain an even temperature during the severest weather. The heating and ventilating plant was designed by the Q. N. Evans Construction Company, the Johnson system of heat regulation being employed. In the Seventy-second street end of the basement a cold air chamber was constructed, which communicated directly with the outside atmosphere. Steam coils were placed in this chamber, so located as not to obstruct the free passage of the air, but still to render it impossible for the air to enter the building without coming in contact with some portion of the coils. At the inner outlet to the air chamber is placed a 9-foot Sturtevant blower, which draws in the air from the outside and forces it through galvanized iron pipes or ducts to the bottom of flues leading to the various rooms above. To guard against the wide variations in the temperature of the external air, some provision for heating the air admitted must be provided, and here the aid of electricity was invoked, and the Johnson system of heat regulation introduced. On the main steam supply leading to the coils, diaphragm valves were placed, which were operated by a thermostat placed in the duct leading to the base of the vertical flues. This thermostat, being set at the desired temperature, say, 70 degrees, if the temperature of the air falls below that, the valve in the steam pipe is automatically opened and steam admitted to the coils. As soon as the air is heated to a temperature above 70 degrees, the electrical contact is reversed, the diaphragm valve closed and the temperature allowed

A BIT OF CEILING IN THE READING ROOM.

to fall. This automatic regulation is found to be most sensitive and reliable.

This general regulation of the temperature of the air admitted, however, would only insure certain uniform results, and would not admit of variation in the temperatures of the different rooms to suit their respective locations and purposes. Accordingly, each flue leading to the apartments above is provided with a stack of coils connected with the steam supply. In each of these coils, or the steam pipes leading to them, is placed a diaphragm valve, operated as described above, by a thermostat, which, however, is placed in the particular apartment to which the flue leads, and set at the required temperature. Suppose that a particular room is at the proper temperature; the thermostat will have automatically closed the valve in the stack at the base of its flue, and the air at 70 degrees, as required by the thermostat in the main duct, will pass up to the room. Should the room require heat at any time, its thermostat will open the valve in its stack, and the air, coming from the main at 70 degrees, will pass through the steam coils of the flue in question, receive addi- heat and enter the room through the register in the ceiling, where, gradually falling as it cools down, it passes out through the ventilator at the floor level. Meantime the upper ventilator is closed so as to prevent the escape of the heated air, but when the room is warm enough, the thermostat closes the diaphragm valve in the basement and simultaneously opens the upper ventilator. The circulation of the air is so gentle that there is no appreciable draught.

AT THE 'PHONE.

The method of refrigeration, while not involving any electrical features, is of considerable interest. The Pictet system is employed, which consists in brief of the circulation of brine, by a series of pumps, to various portions of the building, such as the wine cellar, the pantry, the kitchen, etc., the brine being cooled by contact with coils cooled by the rapid expansion of gas. This system is operated by a small Corliss engine.

THE COLONIAL CLUB BY NIGHT.

The entire power plant has operated most successfully and at a high efficiency. The whole installation, including the electric light plant, the ventilating and refrigerating systems, pumps and an elevator, has run on an average daily consumption for the year of 2¼ tons of coal.

AT THE TICKER.

The Incandescent Lamp Situation.

Answers continue to come in to the questions suggested by a correspondent and published in the last issue of The Electrical World: First, "Is it possible for the General Electric Company to obtain control of the lighting industry?" Second: "Should the General Electric Company obtain control of the lighting industry, would the effect on the electric lighting business, on the whole, be beneficial or otherwise?"

Mr. H. Ward Leonard, whose long experience as an electrical engineer and contractor, and whose former position with the Edison company, eminently qualify him to give an opinion, writes as follows:

1. I do not believe that it is possible for any one company to obtain control of the lighting industry, except temporarily. While it has been possible by consolidating many interests in such lines as telegraphy, telephony, oil, cordage, lead, copper, steel rails, anthracite coal, etc., to practically control the market, no such result is likely to be possible in a business which is expanding so rapidly as the electric lighting industry, and which presents so many possibilities in the line of inventions, which will materially affect the situation.

Such a reward as would be offered successful inventors would stimulate inventions to an unprecedented degree, and no truer remark was ever made than that "Necessity is the mother of invention."

We have all seen the time in recent years when it seemed that a company controlling the arc and incandescent lighting business would control the electrical industry; but when necessity arose new and independent, and oftentimes superior, systems were rapidly developed by new companies, and the development of the electric railway made the entire former field of operation fall into insignificance. The electrical transmission may be the next great development in the electrical field, making it possible for new companies to be practically independent of existing electrical industries and patents, and with such radical inventions as those of Tesla, the patents and commercial supremacy of those in control of the field to-day will be powerless to maintain control of the field, even with practically unlimited capital.

2. If any one company should temporarily secure the control of the electric lighting business, it would unquestionably damage the electric lighting business generally, and would be likely to reduce the profits of such a controlling company, for the only successful trusts for a public necessity are those which supply the public as formerly, both as to price and commercial restrictions, and whose earnings are increased by the reduction of general expense and the increase in the demand by better accommodations offered the public.

The general apathy and lack of business in the incandescent lighting industry during the past few months have been unparalleled in the history of the business, and are undoubtedly due to the fact that all consumers and contractors are awaiting the final action of the General Electric Company, so as not to assume unknown risks.

The owners of the Edison lamp patent are, no doubt, entitled to damages for past infringement, and are justified in charging any price heretofore asked for incandescent lamps and in protecting the lincensees in their exclusive territorial rights to the lamp, but any attempt to control the sale of dynamos, sockets, switches, wires, engines and such essential features of any incandescent lighting plant through the agency of the lamp seems to me ultimately impossible and not likely to benefit any interest.

A clear and explicit statement from the General Electric Company of the policy it intends to pursue would in any event be immediately and greatly beneficial to the electric lighting business

Another gentleman, well versed and deeply interested in the question, said that in his opinion the only thing to be done now was to determine exactly the status of the Edison patent. In the Beacon case, the question of the practicability of lamp 1, 2 and 3 was raised, and doubt had been cast upon the genuineness of exhibit No. 4. These question will again come up at St. Louis on April 11, when the final trial of the suit against the Columbia Incandescent Lamp Company will be heard. He believed that testimony was already at hand to establish beyond doubt that Goebel invented the incandescent lamp before Edison had anything to do with it. For use in the Beacon case the evidence on this point had been gathered in two weeks. Since then he understood that a large expense had been incurred in obtaining additional, and, what he considered, convincing evidence. It is believed by those who ought to know that a very strong case will be presented at St. Louis, and that the Goebel lamps, which Judge Colt thought were inoperative, will be proved to be in every way practical. This gentleman believes that it is the duty of every one interested in the lamp question to hold up the hands of those who are fighting for the cause. This they can do both by contributing to the expenses of the coming suit and by giving them their moral support. While there is nominally but one defendant in this case, the whole electric industry is practically co-respondent, and should stand shoulder to shoulder as in a common cause and assist to bear the common burden.

If the Edison claims were defeated, all the perplexities of the situation would vanish, and toward the accomplishment of this much desired end all should unite.

A representative of The Electrical World called upon a gentleman occupying a responsible position with one of our largest electrical supply houses, and in response to these questions, he stated that in the first place he did not think it possible for any one company to monopolize the electrical business, and, in the second place, that were such monopoly possible he would unhesitatingly characterize it as disastrous in the extreme to that business. While he believed that the incandescent lamp was the key to the situation he also believed that it would be impossible to so hedge it around, either by capital or by patents, as to render it impossible for competition to arise. He pointed to the Bell Telephone Company business as a monopoly, which had been protected from the very start by the broadest patents and enormous capital, and predicted that notwithstanding the great advantages under which this monopoly was now controlled, both in the way of acquired franchises and established business, that on the expiration of the fundamental patents it would be almost immediately overthrown. "There is no question," he said, "that Bell's fundamental patent will expire next year." The Edison lamp patent will also expire not far from the same date, and the two monopolies will then almost simultaneously come to an end, and he looked for great activity in both lines at that time. In the mean time invention has been stimulated to produce something better than that which the monopoly had controlled, and he believed that while in the case of the lamp industry the enforcement of its legal rights by the General Electric Company has worked great temporary hardship, it would eventually result in a benefit to the public at large. For obvious reasons he declined the use of his name in connection with his remarks, for, as he said, he was but expressing the opinion of an individual, while his concern was a corporation, and corporations have no opinions.

Mr. C. H. Wilmerding, general manager of the Chicago Arc Light and Power Company, writes as follows:

"The questions which Mr. Terry propounds scarcely seem to me to be capable of much discussion, for the reason that, in my opinion, the first question can only be answered in the negative. I do not believe that it would be possible for the General Electric Company, or any other single corporation, to obtain complete control of the lighting industry. The influence of such combinations, however, I believe to be generally beneficial, as thereby a superior grade of goods can be put out at a smaller cost. This is also the usual result of such combinations, though the popular belief is that they are formed only for the purpose of 'robbing the public.' Mr. Terry is misinformed as to the suppression of the remarks at the St. Louis convention in reference to the incandescent lamp in the official reports. The matter ordered to be omitted from these reports was only that which was of a personal nature between Dr. Louis Bell and Mr. T. Carpenter Smith."

The following communication is from a large lamp consumer in New York City who derives his current from an isolated plant of his own, and may perhaps be taken as representative of the opinion held by that large and important class, the consumer:

I have received a communication from the office of the Edison Illuminating Company, of New York, forwarded to us by registered mail, stating in courteous, but decisive language that unless we purchase from the said company—which is the local licensee under the Edison patent—all our lamps, we will be liable to a suit at law.

While admitting the power of the company, under its patents, to take the position with us which it does; as a consumer, I feel that the letter sent us, which I trust you will be able to print in some part of your columns, contains in several of its lines, a polite, but forcible series of reminders that we are law breakers, and it also seems to me, by reading between the lines, the beginning of what may be a gigantic plan of the Edison Illuminating Company to control the entire electric lighting and power interests in New York City.

There is no question the end which the Edison Illuminating Company would most desire would be to supply office buildings, hotels, theatres, and possibly factories, with all their light and perhaps their power from central stations. In that way the monopoly of the illuminating company would be complete—that would be the end to which it seems to me it is aiming how to supply from central stations; how to avoid and counteract the use of isolated plants, and how to control and fix to suit itself the individual wiring of separate buildings and plants.

In a business sense it occurs to me that this would be the end most desired by the company, and the end which they would endeavor to reach. The question must occur to each consumer receiving one of these registered letters, "Do I, by purchasing the Edison lamps, thereby rid myself until the end of the patent of any further annoyance, or am I subjecting myself, by giving in at the outset, to the demand of the company, to a series of culminating annoyances by which the Edison Illuminating Company will seek to control all my lighting and power facilities?"

In other words, is it not better to throw down the gauntlet at once and stand the risk of a possible fight, or is it wise to meekly give in to what undoubtedly is the order of the court and the right, according to law, of the local Edison Illuminating Company to supply incandescent lamps in this city?

This is the question which consumers are called upon to answer—whether to fight or whether to lie down and take their medicine as behooves meek-minded and humble-spirited citizens.

There is no question but what the Edison company are the only ones who for the next year or so can sell incandescent lamps manufactured under the Edison patents. There is no question that if the consumers purchase such lamps from outside companies, not authorized, he renders himself liable to a lawsuit. The consumer, taking all these facts into consideration, is in a peculiar position. There is apparently only one way out of the dilemna. What the next move of the company will be we do not know, but that it has a large and excellent stack of cards up its sleeve which it is prepared to play, we have no manner of doubt. The matter may end, possibly, when the pressure brought by the company, which it seems probable will occur later on, becomes too heavy, ending perhaps in a combination of the large consumers to restrict as far as possible the use of electric light. Any extreme pressure brought by the company on the large users of electric light would result at once in such a petition being passed aroung among the hotels, office buildings and theatres, in which the public would be asked to bear with the inconvenience temporarily until such arrangements could be made, either at the expiration of the patent or with the present company, as would suffer the consumer to live in peace and quietness unhampered in his business arrangements.

It may seem that I am taking too forcible a view of the future aims of the company, but it occurs to me that were I in its position to-day I should force the matter as far as possible to the end which I have stated. I presume it has considered the same end very clearly itself, and it is merely a question with it of ways and means, and it is these very ways and means that will press perhaps unbearably upon the consumers. It will not do for the consumer to wait until the game is half played out by the company before making an effort to get back to the starting point. Now is the accepted time, and it is now that it behooves every consumer to watch with the utmost care the next move made by the company.

The following is the communication referred to above:

THE EDISON ELECTRIC ILLUMINATING CO. OF NEW YORK,
GENERAL OFFICES, PEARL, CORNER ELM STREET,
NEW YORK, March 15, 1893.

Sir: You are aware, from the notices in the public press, that the opinion of Judge Wallace, in the United States Circuit Court, July 14, 1891, and the decision of Judges Lacombe and Shipman, in the United States Circuit Court of Appeals, Oct. 4, 1892, have confirmed the right of Thomas A. Edison, as the inventor of the incandescent electric lamp, to the sole benefit of this invention, which is the necessary basis of all incandescent electric lighting, and upon which every other incandescent lamp is an infringement. The inclosed notice schedules injunctions based on these decisions.

The Edison Electric Illuminating Company, of New York, which at its Pearl street station originally developed the system of commercial electric lighting made possible by this invention of Mr. Edison, is about to cause proceedings to be instituted against users of non-licensed incandescent lamps within its territory, for the loss to it caused by their infringement of the Edison patents. During the long period of costly litigation, pending the final vindication of Mr. Edison's rights by the courts of last resort, electric lighting companies and manufacturers of electric lighting apparatus have assumed to avail themselves, without payment, of the inventions for which this company has paid large sums, and upon which it has based large investments. This company is informed that such concerns have in many cases sold or installed non-licensed incandescent lamps with a guarantee to users that they should be protected against damages from infringement. No such agreement can be recognized by this company as a defence on the part of individual infringers who have used non-licensed lamps on their premises.

This company is, nevertheless, offering to negotiate with manufacturing and other concerns which have supplied non-licensed incandescent lamps within its territory for a general settlement, covering individual customers. It cannot jeopard its rights, pending any such general settlement, by refraining from proceeding against individual users who have installed or used infringing lamps, in the face of abundant public notice, or by permitting delays which might result from negotiations entered upon or continued for purposes of delay. It is, nevertheless, disposed to avoid unnecessary vexation to individual users, and will be prepared to negotiate a settlement on a fair basis with users who promptly forward a schedule of the number and character of lamps installed, and the number of non-Edison lamps used to the present time, and who now agree to purchase only properly licensed lamps. In case of a general settlement covering such individual use, the claim for individual settlement for past damages will of course be waived. The general agent of the company has instructions to call personally or by representative upon such users, and has authority to open negotiations for settlement on more favorable terms to individual infringers than would result from litigation.

It is the policy of this company to make the use of electric light as general as possible by reducing the price as fast and as far as the increase of demand permits a decrease of cost. In pursuance of this policy, the rate per lamp hour has been made very liberal for large consumers by a discount, based upon the amount of use, and in cases where an isolated plant has proved unsatisfactory, vexatious or the cause of annoyance by vibration or otherwise, the general agent will be glad to negotiate for the supply of current directly from our stations at a price which includes the renewal of lamps without extra charge. Truly yours,

THE EDISON ELECTRIC ILLUMINATING CO. OF NEW YORK
By B. B. BOWSON,
First Vice-President.

Mr. F. P. Fish, general counsel of the General Electric Company, than whom no one can speak more authoritatively, was asked for his views on the subject by The Electrical World, and in the course of a somewhat extended conversation said that in the first place he did not think that it was possible for the General Electric Company to control the lighting industry of this country, as some feared, nor had that company any intention whatever of attempting to do so. For that reason it was unnecessary to discuss the second question.

As regards the policy of the company, he and the officers of the General Electric thought at one time that they had some more or less definite ideas on this subject, but at present no policy can be announced or even considered until the litigation shall have been ended. The situation, he added, is an exceedingly complicated one, as every person who has studied it knows. There are the rights of central station managers and of the consumers on the one hand and of the General Electric Company, the Edison licensees and the Thomson-Houston local companies on the other, and also the rights of the West-

inghouse and other opposition companies, and of those using apparatus and lamps not manufactured by the General company, as well as the rights in the premises of the dealers in electrical supplies, contractors and engineers whose business it is to supply plants and who, through no fault of their own, find their business temporarily interrupted by the element of uncertainty as to whether those contemplating putting in electric lights may be able to buy lamps for use in connection with the apparatus manufactured by other companies.

None deprecated this unsettled condition of the lamp question more than the General Electric, but in the opinion of Mr. Fish no further step in the matter can be taken until the question of the litigation has been settled and the situation has been accepted by those in interest. Then the General Electric will be perfectly willing to arrange matters in a manner which Mr. Fish thinks will be not only fair and equitable, but even satisfactory all around.

Although the element of the Edison licensees in a measure complicates the situation, Mr. Fish says that no difficulty or embarrassment has been experienced from these gentlemen, who have been very reasonable, very considerate and who are working in perfect harmony with the General Electric in the matter.

Mr. Fish and the officers of the General Electric Company had supposed that when the validity of the Edison patents had been established in the Sawyer-Man case, at an expense of several hundred thousand dollars, that would end the matter, so far as its rights to the lamp was concerned, and no further trouble on that score would be encountered. To their surprise, however, the outside lamp manufacturers had gone complacently on, without as much as saying "by your leave," and had defied the company, which found that the only course open to it was to enforce its rights.

Mr. Fish says that he and his assistants have their hands full just now with the lamp manufacturers, against whom they have asked restraining orders, but who are contesting every inch of the ground. The next case, that of the Columbia Incandescent Lamp Company, comes up at St. Louis in April. The defence will be along the general line adopted by the Beacon company. Until this and the other cases are decided nothing in the way of a policy can be announced. A restraining order will be asked against every infringing lamp manufacturer just as soon as the company's lawyers can get around to him. That, Mr. Fish feels, must be the first step. Then the company will be ready to talk about arranging matters so that business can go on, but not before.

As regards the sale of lamps, Mr. Fish thinks that the action of the General company in an exceedingly embarrassing and complicated situation has been misinterpreted by the public at large. It would be very clear to any one that its obligations to its lincensees would not permit it to sell lamps indiscriminately without knowing where and by whom they were to be used. Cases have already occurred where lamps thus sold had been taken directly into the territory of Edison lincensees, and used in direct competition with them, and had thus given what he considered to be just cause for complaint. The company does sell lamps for use in connection with apparatus furnished by other companies, but it requires when an order is received that it should be informed where the lamps are to be used. In such cases it supplies the lamps necessary for immediate use, providing they are not to be used in competition with or in derogation of the rights of those whom it is legally bound to protect. It does not care to sell lamps in large quantities, or largely in excess of the demand, nor does it care to have the prices quoted or even the fact that it supplies the lamps under the circumstances considered as a precedent for the future.

When an order comes from a central station, isolated plant or other users, there is not much difficulty in the matter; but when an order comes from a supply dealer, who from the nature of his business expects to supply all orders from whatever source received, it becomes necessary for the company to require with the order assurances as to the use to be made of them, and their destination. This has been construed by some supply dealers as an unwarranted interference with their business, but Mr. Fish thinks that no one can consider the matter from all points of view without seeing at once that it is the only possible course open to the General Electric Company. An order that would be filled direct for a consumer would also be filled through a supply dealer, so that there is no discrimination in the matter.

It would be seen, Mr. Fish said in conclusion, that if the company is justly entitled to the Edison patent, which has cost it so much, it is also entitled to protect that patent against all infringers; also, that its licensees who have paid for exclusive privileges under it are entitled to protection in the privileges thus purchased. Until the final decision in the cases now pending, it would be impossible to lay down a more definite course of action, but he was happy to say that, as a rule, both the central station managers and the licensees of the Edison and of the Thomson-Houston companies have looked at the question fairly and reasonably, and that almost all of the trouble has arisen from those who have been considered in all the decisions of the courts thus far to be infringers and as having no legal rights in the matter whatever.

It was stated in another issue that the probable result of the lamp decision would be to incite manufacturers to invent a new lamp which would not infringe on the Edison patent. This seems to be the line in which manufacturers are now working; as, for instance, the Sunbeam company is ready to commence work with a new lamp. A new one is also announced from abroad, to which reference is made elsewhere.

Boston & Montana Electrolytic Copper Plant.

H. R. Caulfield, superintendent of the New England Electrolytic Copper Company, at Central Falls, R. I., has just completed and started successfully a large electrolytic copper refinery for the Boston & Montana Consolidated Copper and Silver Mining Company, at Great Falls, Mont. The main building, which covers 300 × 525 feet of ground, contains 288 depositing vats, which are filled with 1,600,000 pounds of pig copper in the shape of anodes. This plant is capable of turning out 1,200,000 pounds of pure electrolytic copper per month.

The current used for the plant is generated by two multipolar Thomson-Houston dynamos of 165 kilowatt capacity, and is transmitted from the power house to the tank room, a distance of 2,100 feet, through 21 half-inch copper wires. The total weight of copper connections used in the plant is over 55,000 pounds, and to line the tanks and complete the sulphate room it took 650,000 pounds of sheet and lead pipes. The total cost of the plant, aside from real estate, etc., was over $350,000.

Heretofore the Boston & Montana company has not been saving the silver contained in the ore, but now every pound of the copper will be treated electrolytically.

The Most Economical Age of Incandescent Lamps.

The paper which Mr. Carl Hering read before the American Institute of Electrical Engineers on the subject of the most economical age of incandescent lamps, and which was published in The Electrical World of March 18, 1893, excited considerable interest, and, in addition to the discussion which immediately followed the reading of the paper, several important communications were received, which are here given in full:

COMMUNICATIONS.

Prof. Benjamin F. Thomas.—I am indebted to Mr. Hering for a copy of his very interesting and valuable paper, and for the opportunity to contribute a little to its discussion. All who are interested in any way in incandescent lighting, must, with me, feel under obligation to Mr. Hering for the application of the O'Keenan analysis to the data of the Ohio test, and for his skillful interpretation of the results. The original paper and its discussion at Chicago established the fact that lamps last altogether too long for economical results, and also the fact that the lamp of highest initial efficiency is not always the most economical. Mr. Hering's paper now turns the conclusions there expressed in general terms into a complete demonstration, and adds other facts which will doubtless prove quite surprising to many who have made lamp questions a study. If the results are properly understood and applied they must prove to be of great value to the lamp manufacturer, the station manager and his customers, and all who have anything to do with the incandescent lamps. To the owners of isolated plants Mr. Hering has demonstrated the importance of renewing lamps when they read the point of minimum cost. (Why not call it the O. K. point?) It hardly seems right, however, to advise any one to run the lamps until they "die a natural death" when the amount of light afforded is not important. Economy considered, it is better to use, in such place, lamps of the lowest allowable candle power, and to renew them as elsewhere. Central station managers who furnish lamps to their patrons without specific charge for lamp renewals, and who charge by meter record, will of course find it pays best to run the lamps just as long as they can, without causing enough dissatisfaction to seriously affect the number of customers they have. A rough calculation shows that even this case may profit by the deductions of Mr. Hering. The manager who runs a lamp 1,200 hours, instead of renewing at 400 hours, loses 12 cents of profit which he would have made on the larger current which would have passed through the lamp and meter, if he had renewed at the proper time. The strength of the current which flows through the lamp diminishes as the lamp grows old, and therefore the watt hours which will be recorded will be less during the last half of the natural life of the lamp than during the first half. This is of course equivalent to decreasing the station out-put, when lamps are burned as long as they will last. If we ever have lamps produced and sold at about 15 cents, it will then be best for station managers of the class supposed to renew at the 400 or 500 hour point.

It is interesting to note that the man who is a customer of such a central station will find it profitable to buy his own lamps, even though no deduction be made in the price charged by the station. The higher average candle power of the lamps when renewed each 400 hours will enable him to light his premises equally well with a smaller number of lamps, and the saving in his meter bill will more than pay for all the lamps used, and he will have a more uniform and more satisfactory light. It seems not improbable that the central station of the future will limit itself to supplying current through its mains, the one who buys current furnishing his own lamps, fixtures, wiring, etc., and the fact last considered ought to be helpful in bringing about that state of things.

Mr. Hering's Fig. 3 furnishes a very striking view of the relative values of several lamps as money savers. At 400 hours, lamps a, k, f and m are very close together, the extreme difference in cost of 1,000 candle hours being only 1 cent. Where the difference in cost of light is so small it matters little which lamp be chosen, unless the user of the light is particular about uniformity of candle power during the 400 hours.

Referring to Table IV. of the paper read at Chicago,* the percentages of original candle power were, at 400 hours, for a, 74 per cent.; for f, 77 per cent.; for k, 78 per cent., and for m, 90 per cent. The m lamp is therefore best, when uniformity of candle power is deemed important. It must be borne in mind, however, that the number of lamps of each make tested was too small to base a sound judgment of relative merit on, and the above comparison must be considered as an illustration only.

Prof. Elihu Thomson.—I have received the advance proofs of Mr. Hering's paper on incandescent lamps. I have very little time at present to add anything to the discussion of the matter. I think his points are well taken, but I also think he is quite right in pointing out that they are theoretical rather than practical. I think his practical rule for the running of lamps, which, as stated by the paper, is to run them until the diminution of incandescence becomes noticeable and then discard them, is a very good one. Whether to break them or not is another question. They are of course still capable of being run at a high incandescence for a short time, if the voltage be increased. In fact, looking at the matter again from a purely theoretical standpoint, it strikes me that the ideal condition for running is to start the lamp at the potential for which it is made and gradually increase the potential so as to keep up a fair or uniform light efficiency regardless of the life of the lamp, letting the lamp go when it will. Of course this is not practical in most systems, but it can be approximated by putting the older lamps on parts of the system which have the highest potential where there exist differences of potential. It also strikes me that the calculations will need to be varied with every change in the time of running of a lamp; in other words, if out of a set of lamps there are some which only run a short time for each day, while others run a much longer time, the time for discarding a lamp will vary theoretically, in this case. The short time lamps demand, theoretically, a higher light efficiency throughout their use.

It still remains, after the discussion, that we should not relax our efforts to obtain a lamp with long life, and one having an economical efficiency during that life. Furthermore, it is evident that the longer the life of the lamp, if the economy of the light production is maintained, the less in proportion becomes the cost of renewal to the other expenses. There is something to be said also on the score of the convenience of use of the long life lamps as against a lamp which runs down rapidly, which, in a discussion like this, is liable to be left out of the question. Where lamps require to be renewed very frequently, and are somewhat inaccessible in their placing, the long life lamps have an advantage in the saving of labor.

In my opinion, the development of the manufacture of incandescent lamps will give rise to the production of lamps of short and long life to suit the varying conditions in practice and the relative cost of power to cost of lamp renewals.

Prof. E. P. Roberts.—It was my intention to attend the meeting of Feb. 21; having, however, changed my plans, and being very much rushed, I only have time to drop you the following brief memoranda:

1. An instructive line of investigation, following the method of Mr. Hering's valuable paper, would be to determine the comparative value of lamps "L," 3.8 watts at start, 5.5 at 500 hours, and "M," 4.8 at start, and 5.1 at 500 hours.

2. Undoubtedly, blackened lamps should be either destroyed or used where amount of light is of little consequence, or used for resistance racks.

3. That as long as lamps have a 90 per cent. probability of being operated anywhere from 2 per cent. below normal voltage to from 10 per cent. and upward above that, the practical rule, "Smash blackened lamps," should be supplemented by, "Pay the interest on $75.00 for a first class portable voltmeter, use same frequently and systematically all over the circuits, and give the medicine called for by the diagnosis," which might be further supplemented by, "If, after knowing the disease, you will

* THE ELECTRICAL WORLD, July 16, 1892.

not pay for the medicine necessary to make a cure, do not complain if patients die young."

DISCUSSION.

Mr. W. D. Weaver.—The paper of Mr. Hering is one of unusual value, not only on account of the matter contained, but also from the important practical bearing of the subject.

The graphical method which Mr. Hering adopts is very interesting, and the curves enable one to easily follow and thoroughly understand the steps that lead to results that at first sight are rather startling. In this respect the graphical method is superior to an analytical one, but it has the misfortune in this case of being extremely laborious in application, and lacking in accuracy unless the curves are laid down on a large scale.

An inspection of Prof. Thomas' table, giving the variation of watts with the life of a lamp, shows that the rate is very uniform in the majority of the tests and numerically equal to an increment of .3 watt per candle power per hundred hours. The regularity in these cases enables an analytical method of remarkable simplicity to be applied to the solution of the various problems considered graphically by Mr. Hering, the development of which is as follows:

Let T = total cost of 1 c. p. of light for a given number of hours.
" y = average hourly cost during the same period.
" a = cost of lamps per candle power.
" b = cost of one electrical horse power per hour delivered at the lamp.
" w = initial watts per candle power.
" k = increase of watts per candle power for each hour of the life of the lamp.
" x = hours that the lamp is used.

Assuming that the increase in watts per candle power is by equal increments for equal increments of the time the lamp is burning, the watts being used at the time x are w + k x, and the total watts being used at the time x are:

$$\int (w + k\,x)\,d\,x = w\,x + \frac{k\,x^2}{2}$$

The total cost, including the lamp cost, is therefore

$$T = a + \frac{b\,w\,x}{764} + \frac{b\,k\,x^2}{2 \times 746}$$

The average cost is

$$y = \frac{T}{x} = \frac{a}{x} + \frac{b\,w}{746} + \frac{b\,k\,x}{2 \times 746}$$

which is a minimum when

$$x = \sqrt{\frac{2\,a \times 746}{b\,k}}$$

If A is the cost of a 16-c. p. lamp and K the increase of watts per hour for a 16-c. p. lamp, the formula becomes

$$x = \sqrt{\frac{1492\,A}{b\,K}}$$

The value of k from Prof. Thomas' experiments is .003, and consequently K = .048; substituting, we have finally for the life, L, or the "smashing point,"

$$L = 176\sqrt{\frac{A}{b}}$$

By substituting the corresponding values of a and b, the minimum values of the life measured from the final curves laid down in the graphical method are at once obtained from this formula, and it is remarkable that such a simple equation can replace a graphical method so unusually involved. The accuracy of the method of course depends upon the assumption in regard to the arithmetical increase of watts with the life of the lamp, but an inspection of Table I. shows that in most cases an error in this respect is less likely to cause a serious error in the final result than the graphical method, unless the scale of the latter is large.

A singular deduction from the formula is that the "smashing point" does not vary with the watt efficiency of the lamp. Consideration, however, shows that the factors of the question of efficiency are merely the relation between the hourly lamp cost at a given time, and the increment of lamp energy at the same time, and as this is independent of the watt efficiency of the lamp, the latter does not enter.

As the most economical life varies directly as the square root of the cost of the lamp and inversely as the square root of the cost of the power, considerable variations in these values will not introduce large ones in the value of L, as the following table shows:

VALUES OF L.

	b = 10 cents.	b = 4 cents.
A = 35 cents	333	510
A = 45 "	370	580
A = 55 "	404	650

The formula just deduced is based upon a constant value of K. Where this value varies materially, the following arithmetical method enables the "smashing point" to be determined, and also gives the ordinates of the curve showing the variation of the average cost of the unit light, the same that Mr. Hering constructs graphically.

In the tables below, which are based on lamps A and M, of Prof. Thomas' experiments, the hours the lamp has been used are in column A, and the watts at the end of each 100 hours in column B. The increase for each 100 hours is in column C, and the total increase at the end of a given period in column D. The cost of this increase at 15 cents per 1,000 watt hours is given in column E, and the average cost per 100 hours in column F, while column G gives the corresponding average cost of the lamp per candle power per hundred hours, the cost of a 16-c. p. lamp being assumed 45 cents. Column H gives the gain per candle power per hundred hours from the continued use of the lamp, and column I the loss, these quantities being the sums of the values in columns F and G, and corresponding to the ordinates of Mr. Hering's curve e.

Referring to the first table, it will be seen that at 300 hours the average cost of the increased watts required to maintain the unit length is .8 cent per hundred hours, while an average of .94 cent is saved by continuing the use of the lamp; at the end of 400 hours, however, these quantities are 1.031 and .7, respectively, showing that the cost of the increased power has become greater than the saving from the continued use of the lamp. The exact time when the average increased power cost is equal to the average lamp cost is the "smashing point," and may be determined approximately by a proportion between the quantities for 300 and 400 hours.

The following formula enables the quantities in column D to be quickly calculated:

$$D = \frac{1}{4}\left(n\,a + (n-1)\,b + (n-2)\,c_{\cdot} + d\right) - \frac{a + b + c + d, \text{ etc.}}{2},$$

where n = the hours in hundreds and a, b, c, d, etc., the values for 100, 200, 300, 400, etc., hours from column C.

LAMP A.

A	B	C	D	E	F	G	H	I	
0	3.9	0	0	0	0	0	.....	.....	Minimum at 324 hours.
100	4.3	.4	.2	.3	.3	2.81	2.51	.....	
200	4.6	.3	.75	1.125	.56	1.40	.84	.....	
300	4.9	.3	1.6	2.40	0.80	.91	.14	.....	
400	5.2	.3	2.75	4.125	1.03	.70	.....	.33	
5 0	5.5	.3	4.2	6 30	1.26	.56	.....	.70	
600	5.8	3	5.95	8.925	1.48	.46	.....	1.02	
700	6.1	.3	8.	12.	1.71	.40	.....	1.31	
800	6.4	.3	10.35	15.52	1.94	.35	.....	1.59	
900	6.7	.3	13.0	19.5	2.18	.31	.....	1.87	
1,000	6.8	.1	15.85	23.77	2.37	.28	.....	2.09	
1,100	7.0	.2	18 85	28.27	2.57	.23	.....	2.32	
12,00	7.1	.1	22.50	33.75	2.82	.25	.....	2.59	

LAMP M.

A	B	C	D	E	F	G	H	I	
0	4.8	0	0	0	0	....	.....	.....	Minimum at 680 hours.
100	4.7	— 1	—.05	—.075	—.075	2 81	2.88	.....	
200	4.7	.0	—.15	—.225	—.112	1.40	1.47	....	
300	4.8	.1	05	.075	.025	.94	.91	.....	
400	4 9	.1	.2	.3	.075	.70	.62	....	
500	5.1	.2	.5	.75	.15	.56	.41	.....	
600	5.5	.4	1.1	1.65	.276	.46	.18	.....	
700	5.8	.3	2.05	3.075	.44	.40	.....	.04	
800	5.9	.1	3.1	4.65	.58	.35	.....	.23	
900	6.1	.2	4.5	6.75	.75	.31	.....	.44	
1,000	6.1	.0	5.9	8.85	.88	.28	.....	.60	

The American Institute of Electrical Engineers.

At the seventy-fifth meeting of the American Institute of Electrical Engineers, Mr. Charles H. Emery, Ph. D., read a paper on "The Cost of Steam Power Produced with Engines of Different Types Under Practical Conditions; with Supplement Relating to Water Power." This was a repetition of a lecture delivered by him before the Sibley College on Jan. 20, which was in substance a reproduction brought down to date of his original paper on the "Cost of Steam Power," published in Vol. 12 of the Transactions of the American Society of Civil Engineers, November, 1883.

The paper was a lengthy one, but its extent was fully justified by its importance. Dr. Emery, however, read it by abstract, which brought out the salient points, and gave opportunity for an interesting discussion. The importance of the paper attracted a number of the prominent members of the American Society of Mechanical Engineers, some of whom took part in the debate. There can scarcely be said to have been any criticisms, for the remarks were almost uniformly in support of the conclusions reached by the author.

As an introduction to the paper, Dr. Emery stated that on investigation it appeared that the original paper is still substantially correct for the particular purposes to which it was originally applied. It was designed to show the capitalized or present value of steam power in different units maintained forever. The cost of the power in pounds of coal was, for the larger engines, based on testimony taken relative to large sized condensing engines operating regularly at Fall River, Mass. This was distributed by judgment to the amount of water evaporated in the boilers per pound of coal, and required by the engines per horse power. But such distribution evidently did not affect the final results. The prices of engines and boilers employed were higher than the ruling prices to-day, but these form a small percentage of the total capitalized values. In the present paper, instead of revising the former tables, it had been decided to compare the cost of developing a given amount of power with several of the different kinds of steam engines now in general use. A unit of 500 net h. p. had been selected for the purpose. In order to make the comparison at the same speed, it was assumed in all cases that the power was delivered at a speed of 250 to 350 revolutions per minute, corresponding to the jack shaft speed of slow speed engines and the actual speed of high speed engines. All the principal causes which affect the cost of the steam power in engines of different types operating under practical conditions were considered. Many of these have heretofore been neglected or inadequately discussed, so that their very important bearing on the results has not been generally understood. By giving all of these their due weight, it was shown that such additions of expenses are fairly constant independent of the type of engine, and that, without considering either interest or dividends, they in some cases equal the cost of the coal.

He showed that, therefore, in comparing two engines, of which both are good, so that one, for instance, will only effect a saving of coal compared to the other of, say, 12½ per cent., making the relative costs of fuel as 8 to 7; if additional costs equal to the former be added to both, the relative economies will be as 15 to 16, and the saving reduced to 6¼ per cent., simply by the summation of costs. If, then, it be assumed that all expenditures shall pay 10 per cent. interest or dividends on capital invested, and 10 per cent. of the difference in first cost of the engines equals an amount which represents a saving of 6¼ per cent. of fuel, then the cost to the owner of the steam plant will be exactly the same in the two cases, since in one case he will pay in additional interest or dividends, on the capital invested, the same sum as he would pay for additional fuel if he used the cheaper engine. And that in general it would be found that the mere cumulation of costs other than for fuel or interest had the greatest effect in reducing the percentage of saving due to a more economical consumption of fuel, and that a consideration of interest and dividends might simply neutralize or reverse the percentages that were already made very small from the first named cost.

The original cost of the plant was evidently of great importance where, on the one hand, money was dear, or, on the other, coal was cheap or the working irregular. When the interest or dividend charges were duly considered, it would be apparent that the number of hours an engine operates in a year had a very important influence on the question of first cost, as such charges for a given steam machinery would be exactly the same, whether the latter were operated one hour per day during part of the year or 24 hours per day for the entire year, and the interest would also be the same whether the coal used cost $1 or $10 per ton. The saving in the total cost of coal consumed either during the short hours or at the low price per ton, would evidently not be such as to warrant the adoption of high priced steam machinery.

The comparisons which he instituted are given in the accompanying tables, which are largely self-explanatory. For their full understanding, however, reference must be had to the original paper, where the full meanings of the figures are quite definitely pointed out.

After considering the various elements involved, he gives in columns G to N, inclusive, the total cost per net horse power per year on the basis shown in the previous columns for coal at $2, $3, $4 and $5 per ton; first for 308 days at 10 hours each, and, second, for 365 days at 20 hours each. These show clearly that for cheap fuel and short hours the engines of fair economy and least cost give the most economical results, when both the cost of fuel and collateral and interest charges are considered. Such a result, he says, would be anticipated in comparison with non-condensing engines, but it it somewhat surprising to find that the compound engines of comparatively moderate price show better economy, everything considered, than the higher priced triple compound engines. It is also interesting to note the similarity in final cost.

For, in examining columns H, I and J, although we find the total cost per year increases, the relative cost for engines of different kinds varies but little. Columns O to V, inclusive, show the total cost per net horse power per year for electric railroads and other variable work requiring 50 per cent. extra plant to obtain on the average 500 h. p. From these he deduces the surprising information that although the costs have necessarily all been raised, the general relations for the different engines have been very little modified. They show that for short hours and low priced coal, the medium priced engines show, if anything, still better results than on the previous basis, and the higher priced engines only show to advantage for long hours and high priced coal, as shown in column B.

To show the effect on the results of the use of cheap boilers, reference is made to Table II., where the figures are given on the basis that boilers will be employed costing $5 less per horse power than those referred to in Table I.

In connection with these columns, and distinguished by the same letters marked sub. 1, are corresponding columns showing the cost per net horse power per year with the interest and other charges affected by the first cost, reduced proportionately to a reduction of $5 per commmercial horse power on the original cost of the boilers. An inspection of the parallel columns will show at once that the effect has been to favor the engines requiring the use of most fuel—that is to say, the cheaper engines—for the evident reason that as they require more boiler power for a given net power, the reduction

for them is proportionately greater than for the higher priced engines.

In regard to the purchase of the various devices which are urged upon owners of steam plants as saving devices, he claimed that they should be let severely alone unless they would surely save, say, 25 per cent. of their cost annually.

Among other conclusions is that non-condensing engines are inferior at every point to condensing engines, that they are wasteful of fuel when heavily loaded, on account of low expansion, and at light loads the back pressure forms a large proportion of the total resistance. Whereas condensing engines will maintain their economy through a wider range, on account of the reduction of the back pressure. This effect must be particularly aggravated in the case of triple compound engines when used non-condensing.

An examination of the tables emphasizes the fact that the principal difference between the net cost of power under different circumstances is due to the fact that other expenses, except coal and interest, are nearly constant, and the interest intensifies the difference by directly neutralizing, so far as it goes, the economy due to decreased coal consumption.

The tables show conclusively that, for short hours or low priced coal, or both, types of steam machinery to secure the greatest economy of fuel are not warranted; but that for longer hours and the higher prices of coal considered, the more expensive machinery begins to show a commercial advantage, which evidently increases as the price of fuel increases. He, therefore, concludes that to secure the best results, both electrical and otherwise in the cities and towns along the lines of communication, already established, the cheaper engines of simple construction, though not so economical of fuel, will so reduce the capital upon which interest and dividends are to be paid, as, on the whole, to represent not only better commercial policy, but better engineering.

TABLE I.—SHOWING THE COMPARATIVE COST OF STEAM POWER DEVELOPED IN ENGINES OF DIFFERENT TYPES.

BY CHAS. E. EMERY, PH. D., NEW YORK, 1893.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	a
						$g=\frac{fc}{30}$		$i=\frac{g\times 22 \text{ or } 25}{500}$	$j=\frac{8.12\,g}{500}+5.50$	$k=h+i+j$	$l=1.085\,k$		$n=\frac{f}{m}$	$o=\frac{11\,c\,n}{2240}$	$p=\frac{21\,c\,n}{2240}$	
Designation.	Type of Engine.	Indicated horse power required to produce 500 horse power net on high speed engine shaft, or jack shaft of low speed engine.	Steam pressure by gauge.	Feed water per indicated horse power per hour.		Commercial horse power of boilers on basis that one Commercial Horse Power requires the evaporation of 30 pounds of water at 70 lbs. pressure from temperature of 100°	Approximate cost per net horse power.					Water evaporated per pound of coal.	Coal per indicated horse power per hour.	Tons of coal (of 2,240 lbs.) per day with average coal for one hour added for starting and stopping fires.		Designation.
	Name.			Probable limits.	Assumed for comparison.		Engines erected and connected ready for operation.	Boilers erected and connected ready for operation on basis of $22.00 per Commercial Horse Power for steam pressure of 125 lbs. or under and $25.00 for higher pressure.	Buildings and chimney.	Total of the three previous columns.	Total with 2½ per cent. for inspection and 6 per cent. for loss of interest during construction.			For 10 working hours per day.	For 20 working hours per day.	
		I. H. P.	Lbs., sq. in.	Lbs.	Lbs.	C. H. P.	Dols.	Dols.	Dols.	Dols.	Dols.	Lbs.	Lbs.	Tons.	Tons.	
A	Simple high speed, non-condensing	542	100 to 120	35 to 26	33	596	17.50	26.22	15.18	58 90	63.91	8.5	3.882	10.332	19.725	A
B	" low " " "	556	100 to 120	32 to 24	29	537	25.00	23.63	14.22	62 85	68.19	8.5	3.412	9.316	17.785	B
C	Compound high speed non-condensing.	542	100 to 120	30 to 22	26	470	21.00	20.68	13.13	54.81	59.47	8.5	3 059	8.142	15.544	C
D	Special triple compound / High speed non-condensing	542	150 to 170	27 to 21	24	434	26.00	21.70	12.55	60.25	65 37	8.5	2.824	7.516	14.349	D
E	Simple high speed condensing	542	100 to 120	25 to 19	22	397	21.00	17.47	11 95	50 42	54 71	8.5	2.588	6.888	13.150	E
F	" low " " "	556	100 to 120	24 to 18	20	371	27.00	16.32	11.53	54.85	59.51	8.5	2.353	6.425	12.265	F
G	Compound high speed condensing	542	100 to 120	24 to 16	20	361	24.50	15.88	11.36	51 74	56.14	8.5	2.353	6.263	11.956	G
H	" low " "	556	110 to 125	20 to 12½	18	334	30.00	14.70	10.92	55 62	60.35	8.5	2 118	5.783	11.040	H
I	Special triple compound / High speed condensing	542	150 to 170	23 to 14	17	307	29.00	15.35	10.49	54.84	59.50	8.5	2.000	5.323	10 163	I
J	Triple compound low speed condensing	556	150 to 170	18 to 12½	16	297	37.50	14.85	10.32	62.67	68.00	8 5	1.882	5.139	9 810	J
K	do do	556	160 to 170	17 to 12½	15	278	45.00	13.90	8.35	67.25	72.97	8.5	1.766	4.819	9 200	K
L	Do for probable maximum results.	556	160 to 170	16 to 12½	14	259	45.00	12.95	8.15	66 10	71.72	9.5	1.474	4.025	7.683	L

a	q	r	s	t	u	v	w	x	y	z	A	B	C	D	E	F	a
	$q=\frac{2\times 308\,o}{500}$	$r=\frac{3\times 308\,o}{500}$	$s=\frac{4\times 308\,o}{500}$	$t=\frac{5\times 308\,o}{500}$	$u=\frac{2\times 365\,p}{500}$	$v=\frac{3\times 365\,p}{500}$	$w=\frac{4\times 365\,p}{500}$	$x=\frac{5\times 365\,i}{500}$	$y=\frac{3080}{\times .48 \text{ or } .41}$ / 500	$z=\frac{7300}{\times .48 \text{ or } .41}$ / 500	$A=\frac{(.008\,g+3)\times 308}{500}$	$B=\frac{(.008\,g+3)\times 365\times 2}{500}$	$C=0.05\,k$	$D=\frac{l}{10}$	$E=y+A+C+D$	$F=z+B+C+D$	
	Cost of coal per horse power per year.								Cost per net horse power per year of supplies and average repairs.		Cost per net horse power per year of wages.		Cost of insurance ½ per cent.; of taxes 1.2 per cent. of renewals 3.3 per cent. Total 5 per cent. of costs in col. k.	Interest or dividends, say 10 per cent. of costs in col. l.	Total cost per horse power per year of all operating, current and interest expenditures except coal.		
	On basis of 308 days of 10 hours each and cost of coal per ton of 2,240 pounds delivered as follows:				On basis of 365 days of 20 hours each and cost of coal per ton of 2,240 pounds delivered as follows:				308 days of 10 hours each.	365 days of 20 hours each.	308 days of 10 hours each.	365 days of 20 hours each.			308 days of 10 hours each.	365 days of 20 hours each.	
	$2.00	$3 00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00									
	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols	Dols.	
A	12.73	19.09	25.46	31.82	28.80	43.20	57.60	72.00	2.96	7.01	4.78	11.34	2.95	6.39	17 08	27.69	A
B	11.48	17.22	22.96	28.69	25.97	38.95	51.93	64.92	2.53	5.99	4.49	10.65	3.14	6.82	16.98	26.60	B
C	10.03	15.05	20.06	25.08	22.69	34.04	45 39	56.74	2.96	7.01	4.16	9.87	2.74	5.95	15.81	25.57	C
D	9.26	13.89	18.52	23.15	20.95	31.42	41.90	52.37	2.96	7.01	3.99	9.45	3.01	6,54	16.50	26.01	D
E	8.49	12.73	16.97	21.22	19.20	28.80	38.40	48.00	2 96	7.01	3.81	9 02	2.52	5.47	14.76	24.02	E
F	7.92	11.87	15.83	19.79	17.91	26.86	35.81	44.77	2.53	5.99	3.63	8.71	2.74	5 95	14.90	23. 9	F
G	7.72	11.57	15.43	19 29	17.46	26.18	34.91	43.64	2.96	7.01	3.63	8.60	2.59	5.61	14.79	23.81	G
H	7.13	10 69	14.25	17.81	16.12	24.18	32.24	40.30	2.53	5.99	3.49	8.28	2 78	6.04	14.84	23.09	H
I	6 56	9.84	13.12	16.40	14 84	22.26	29.68	37 10	2.96	7.01	3.36	7.97	2.74	5.95	15.01	23.67	I
J	6.33	9.50	12.66	15.83	14.32	21.48	28.65	35.81	2 53	5.99	4.31	7.85	3.13	6.80	15.77	23.77	J
K	5.94	8.91	11.87	14.84	13.43	20.15	26.86	33 58	2.53	5.99	3 22	7.63	3.36	7.30	16.41	24.28	K
L	4.96	7.44	9.92	12.40	11.22	16.83	22.43	28.04	2.53	5.99	3.74	8 87	3.31	7.17	16.75	25.34	L

$C_1 = .0405\,k + .06\,h + .075\,i$

a	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	a
	$G=q+E$	$H=r+E$	$I=s+E$	$J=t+E$	$K=u+F$	$L=v+F$	$M=w+F$	$N=x+F$	$O=q+y+A+\frac{1}{4}D+C_1$	$P=r+y+A+\frac{1}{4}D+C_1$	$Q=s+y+A+\frac{1}{4}D+C_1$	$R=t+y+A+\frac{1}{4}D+C_1$	$S=u+z+B+\frac{1}{4}D+C_1$	$T=v+z+B+\frac{1}{4}D+C_1$	$U=w+z+B+\frac{1}{4}D+C_1$	$V=x+z+B+\frac{1}{4}D+C_1$	
	Total cost per net horse power per year on basis of								Total cost per net horse power per year for electric R. R. and other variable work requiring 50 per cent. extra plant to obtain on the average 500 H. P. insurance increased to 1½ per cent., engine renewals to 4 per cent. and boiler renewals to 5 per cent.								
	308 days of 10 hours each and cost of coal per ton of 2,240 pounds, as follows:				365 days of 20 hours each and cost of coal per ton of 2,240 pounds, as follows:				For 308 days of 10 hours each and cost of coal per ton of 2,240 pounds, as follows:				For 365 days of 20 hours each and cost of coal per ton of 2,240 pounds, as follows:				
	$2.00	$3.00	$4.00	$5.00	$2.00	$3 00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	
	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	
A	29.81	36.17	42.54	48.90	56.49	70.89	85.29	99.69	35 45	41.82	48 19	54 55	62.14	76.54	90.94	105.34	A
B	28.46	34.20	39.94	45.67	52.57	65.55	78.53	91.52	34.55	40.28	46.02	51.75	58.65	71.64	84 61	97.60	B
C	25.84	30.86	35.87	40.89	48.26	59.61	70.96	82.31	31.10	36.12	41.13	46.15	53.52	64.87	76.22	87.57	C
D	25.76	30.39	35.02	39.65	46.96	57.43	67 91	78 38	31.65	36.28	40.91	45.54	52.85	63.32	73.80	84.27	D
E	23 25	27.49	31.73	35.98	43.22	52.82	62 42	72.02	28.08	32.32	36.56	40.81	48.05	57.65	67.25	76.85	E
F	22.82	26.77	30.73	34.69	41.30	50 25	59.20	68.16	28.12	32.07	36.03	39.99	46.60	55.55	64.50	73.46	F
G	22.51	26.36	30.22	34.08	41.27	49.99	58.72	67.45	27.48	31.33	35.19	39.05	46.24	54.96	63.69	72.42	G
H	21.97	25.53	29.09	32.65	39.21	47.27	55.33	63.39	27.36	30.92	34.48	38.04	44 60	52.66	60.72	68.78	H
I	21.57	24 85	28.13	31.41	38.51	45.93	53.35	60.77	26.92	30.20	33.48	36.76	43.86	51.28	58.70	66.12	I
J	22.10	25.27	28.43	31.60	38.09	45.25	52.42	59.58	28.27	31.44	34.60	37.77	44.26	51.42	58.59	65.75	J
K	22.35	25.32	28.28	31.25	37.71	44.43	51.14	57.86	29.10	32.07	35.03	38.00	44.46	51.18	57.89	64.61	K
L	21.71	24.19	26.67	29.15	36.56	42.17	47.77	53.38	28.33	30.81	33.29	35.77	43.18	48.79	54.39	60.00	L

TABLE II.—SHOWING THE EFFECT ON THE COMPARISON IN TABLE I., DUE TO REDUCING THE COST OF THE BOILERS $5.00 PER COMMERCIAL HORSE POWER.

a	b	H	H_1	L	L_1	P	P_1	T	T_1	a
		Total cost per net horse power per year.								
	Type of Engine.	First case. No surplus plant, coal $3 per ton.				Second case. 50% surplus, plant coal $3 per ton.				
		10 hours day.		20 hours day.		10 hours day.		20 hours day.		
Designation.	Name.	H From Table I.	H Red'ced	L From Table I.	L Red'ced	P From Table I.	P Red'ced	T From Table I.	T Red'ced	
		Dols.	Dols	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	
A	Simple high speed, non condensing	36.17	35.23	70.89	69.95	41.82	40.48	76.54	75 20	A
B	" low " " "	34.20	33.35	65.55	64.70	40.28	39.08	71.64	70.44	B
C	Compound high speed non-condensing	30.86	30.12	59 61	58.87	36.12	35.06	64.87	63.81	C
D	Special triple compound high speed non-condensing	30.39	29.70	57.43	56.74	36.28	35.30	63.32	62.34	D
E	Simple high speed condensing	27.49	26.87	52.82	52.20	32.32	31.43	57.65	57.65	E
F	" low " " "	26.77	26.19	51.25	49.67	32.07	31.24	55.55	54.72	F
G	Compound high speed "	26.36	25.79	49.99	49.42	31.33	30.52	54.96	54.15	G
H	" low " "	25.53	25.07	47.27	46.81	30.92	30.17	52.66	51.91	H
I	Special triple compound high speed condensing	24.85	24.37	45.93	45 45	30.20	29 51	51.28	50.59	I
J	Triple compound low speed condensing	25.27	24 80	45.25	44.78	31.44	30.78	51.42	50.76	J
K	" " " " "	25.32	24 88	44.43	43.99	32.07	31.44	51.18	50.55	K
L	Do. for probable maximum results	24.19	23.78	42.17	41.76	30.81	30.22	48.79	48.20	L

THE ELECTRICAL WORLD'S DIGEST

OF

CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

MAGNETISM.

In "Elek. Zeitschrift," Feb. 24, Mr. Roessler begins a long serial on researches on the magnetization of iron under very small and very large magnetizing forces. In the first article he gives a resume of the subject and a discussion of the methods which are applicable. It is of a theoretical nature and belongs under the heading of physics rather than electricity. The second section is devoted to a description of the method, no conclusions being given. In the third section he gives the results for very small magnetizing forces from .0014 to 1.275; the results are given in a table; they show that μ is not constant within these limits. He gives another table of mean values for H from 1.3 to 52.7. The permeability curve of μ as a function of H ceases to be straight after H = .9; it then increases more rapidly and with greater convexity toward the H axis; this curvature reaches its maximum at about H = 1.35; between 1.7 and 1.9 there is a point of inflection; the following concave portion attains a maximum value μ = 2900 at H = 2.7; between H = 4 and 6 there is a second point of inflection after which the curve remains convex.

UNITS, MEASUREMENTS, INSTRUMENTS.

Mechanical Equivalent of Heat.—In a paper before the Royal Society, Messrs. Griffiths and Clark gave the results of a very careful determination in which they find a pound Fah. unit to be equal to 778.99 foot-pounds. They show that Joule's determination should be corrected, and after making the corrections they find that Joule's value is 776.74. (If the value henceforth is to be taken as 779. the electrical equivalent will be as follows:

1 joule = .0009465 pound Fah. heat unit.
1 joule = .0002385 kilogr. Cent. heat unit.
1 kilowatt hour = 3,407 pound Fah. heat units.
1 kilowatt hour = 858.7 kilogr. Cent. heat units.
1 pound Fah. unit = 1,056.5 joules.
1 pound Fah. unit = .0002935 kilowatt hour.
1 kilogr. Cent. unit = 4,193 joules.
1 kilogr. Cent. unit = .0011646 kilowatt hour.)

Resistance and Mechanical Stress.—The Lond. "Elec. Eng." gives an abstract of a paper before the Royal Society, by Messrs. Gray and Henderson, on the effects of mechanical stress on the electrical resistance of metals. They call attention to the importance of using for the specific resistance, that defined by the length and weight of the wire instead of by the cross-section. This obviates the necessity of making the troublesome and uncertain measurements of the cross-section of the wire and only requires to measure the length and the length per unit of weight, both of which can be done with great accuracy. The weight specific resistance was also found to be more nearly constant than the volume unit. The formula then becomes $R = k\ (1 + w)\ l$ in which k is the weight specific resistance of the wire, l is the length and w the weight of the length l. A few figures are given regarding the change of resistance due to mechanical stress. Their conclusions are, that for practical purposes any mechanical treatment, however severe, does not affect the electrical properties of the metals tested.

Postoffice Standard Cell.—A correspondent of the Lond. "Elec. Rev." made a redetermination of the E. M. F. of the Daniell cells of the Postoffice pattern, known as the P. O. standard cell, and finds that it differs considerably from the generally accepted figure 1.07 B. A. volt. He compared it with three perfect Clark cells of absolutely equal E. M. F., which was taken as 1.454 B. A. volt, making all corrections for temperature. With pure chemicals and semi-saturated solutions of sulphate of zinc, he obtains 1.13 B. A. volt in 4 out of 5 cells; with ordinary chemicals and the same solution he obtains 1.13 for 2 and 1.14 for 1. With unamalgamated zinc rods of different kinds he obtains variable results from 1.06 to 1.11; with different copper plates it varies from 1.12 to 1.135; the E. M. F. does not vary perceptibly between 6 degrees and 20 degrees C., though the internal resistance does; the E. M. F. is reduced somewhat when a layer of oxide is formed on the zinc and when the zinc solution becomes saturated.

Meters.—Prof. Fleming, in a recent lecture, calls attention to the importance of changes of temperature in meters, which he claims designers are likely to overlook; he states that resistances should be made of manganin or some such metal; a change of 40 degrees may often occur in cellars of houses and an alteration of 10 to 15 per cent. in the accuracy of the meters might therefore occur if the resistances were made of copper wire.

Slide Resistances.—Messrs. Niblett and Ewen, in their serial in the Lond. "Elec. Eng." give a detailed description, with illustrations, of Mr. Muirhead's new slide resistance box.

DYNAMOS, MOTORS AND TRANSFORMERS.

Armature Reaction.—Mr. Fischer-Hinnen, in the "Elek. Zeitschrift," Feb. 3, discusses at some length the subject of armature reaction and its compensation. He deduces formulas for calculating the counter magnetism produced by the armature, the angle of displacement of the brushes, and from this the ampere windings (that is, the series coils of the compound winding) which are required to compensate for the armature reaction; his final formulas are quite simple and practical, but cannot be given here without also giving the numerous conditions; although not strictly correct, they are doubtless sufficiently so for practical purposes. Additional formulas are also given for multipolar machines. To partially neutralize the armature reaction he suggests laminating the parts of the field magnets (and pole pieces) nearest the armature, in a direction parallel to the axis of the armature; this he claims will increase the resistance of the magnetic circuit of the counter magnetism of the armature. Another method is to place a compensating coil parallel to the armature shaft (and to the axis of the field magnets) and embed it in the middle of the pole pieces, the coil, therefore, encircling the armature; the direction of the current in this coil must be such as to

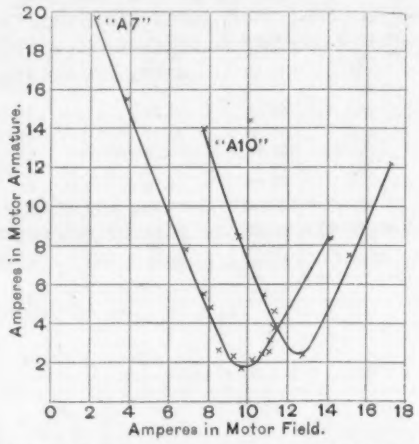


FIG. 1.—POWER FACTOR FOR ALTERNATE CURRENT MOTORS.

oppose the winding of the armature. When this coil is wound so as to be distributed over the surface of the pole pieces, and if the ampere turns in it are always the same as those in the armature (which may be attained by connecting them in series with the armature), the armature reaction will be zero. (It then becomes the method suggested by Prof. Ryan in The Electrical World, Nov. 19, 1892, p. 323.) By introducing this winding in a machine it was found that the output was increased more than 50 per cent. while the sparking was no longer noticeable. (This, however, means very little, as the machine may have been a very poor one before this improvement was added).

Power Factor for Alternating Motors.—In a paper on testing and working alternators by Mr. Mordey (the first part of which was abstracted last week), the conclusion of which is published in full in the Lond. "Electrician," March 10, he discusses the subject of motors. He endeavors to find whether, for alternating current motors, cables and machinery have to be used capable of carrying a large idle current or whether power transmission projects, as far as this point is concerned, can be treated in as simple a manner as with closed circuit transformers. According to his experience with his alternators, the power factor of those machines when used as motors under fair loads is very high if used under conditions that are easily obtained. Fig. 1 shows the way in which the load factor varies with the excitation; one is for a 25 kilowatt and the other for a 50 kilowatt alternator, both running as motors without a load; the ordinates show the current taken by the motor when the exciting current was varied; the motors running at 2,000 volts and at a frequency of 100. It will be seen that in each case there is a certain excitation which reduces the armature current to a minimum, and, therefore, gives a maximum power factor and maximum efficiency. When loaded with varying loads it was found that there was for each load an excitation that corresponded with a minimum armature current; the excitation which gave the lowest armature current (that is the highest efficiency and highest power factor) was approximately the same for all loads, with the same impressed E. M. F. From these curves it will be seen that the power factor varies enormously, but there is no difficulty in making it a minimum and the efficiency a maximum, by always working at the excitation which gives the lowest armature current. It appears that, as was shown by Dr. Fleming to be the case with closed circuit transformers, the power factor approaches unity as soon as a load was put on.

Equalizer for Alternators.—In the same paper Mr. Mordey describes an equalizer to be used in connection with alternators. In alternate current armatures there are advantages in having the coils arranged in two or more parallel portions instead of all connected in series; this, however, has the drawback that unless the coils are all equal and similarly acted upon, the voltages will not be equal in the two portions and a current will then circulate in the armature itself. To overcome this he connects a sort of transformer in the circuit, as shown in Fig. 2. It consists of a pair of similar coils, one placed in each half of the armature circuit; the connections are such that when the two armature currents are equal there is no magnetism induced, and the two windings neutralize each other; if, however, one current should tend to become greatly different, the other will be resisted by the equalizer, which then acts as a transformer, reducing the voltage in one winding and increasing it in the other. In one case in which the circulating current was 16 amperes, the equalizer reduced it to one-half ampere.

Coupling Alternators.—In the same paper Mr. Mordey gave his experience with coupling alternators, the results of which were given in these columns in the issue of March 18. In addition to this he states that when an alternator is to be coupled in parallel with another already running, its field should first be excited, preferably by connecting it in parallel to the same exciting source, as there is then no necessity for adjusting the exciting current, except for slight differences of temperature; after the approximately correct speed is reached, the synchronizer should be switched on and the speed of the engine adjusted until the synchronizer lamp is steady, showing that the two alternators are in synchronism; for greater accuracy, a voltmeter may be used instead; when this lamp or the voltmeter is at its highest, the double pole switch connecting the alternators should be closed; the alternator is then connected, but is doing no work; the supply of steam is then increased until the two ammeters show that the load is equally divided between the machines; when this condition is reached, no further regulation of the engines is required; the control of the E. M. F. is effected by the exciter and not by means of resistances in the field circuits of the alternators; the field ammeter should be observed so as to give each machine the same excitation. To discount one alternator when two or more are running, the load should not be switched off suddenly, but the steam should be gradually reduced by the governor or by the valve, until the alternator is doing no work, as indicated by the ammeter; the main switch should then be opened and the engine stopped. If steam is continued to be turned off beyond this point before the switch is opened, the alternator will take current from the mains and the ammeter will, after having reached zero, again show a deflection;

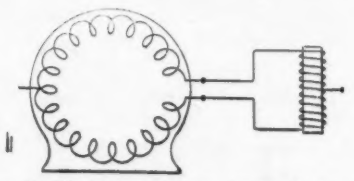


FIG. 2.—EQUALIZER FOR ALTERNATORS.

care should be taken therefore not to pass this point. He states that artificial loads need not be used for connecting alternators in parallel; they are necessary only when the characteristics of the machines show great variations between no load and full load.

The Effect of Frequency in Transformers.—Mr. Steinmetz, in a very interesting and practical article, published in the "Elek. Zeitschrift," Feb. 3, gives the results of some investigations regarding the effect of frequency. He made a number of experiments on a small 500 watt (closed circuit) Westinghouse transformer, built for 138 periods. He ran it at frequencies of 36.3, 137.5 and 204.5 periods. As the loss of energy due to hysteresis is independent of the load, depending only on the magnetization, and as the C^2R loss can be calculated, he made his observations on open circuit only. He describes the transformer in detail, and gives curves showing the results. He comes to the following conclusion: That between 36 and 205 periods per second the magnetic characteristic—that is, the relation of the magnetism and the magneto-motive force, is constant and independent of the frequency. For frequencies up to 200 periods per second, there is no viscous hysteresis, the loss of energy per cycle through molecular friction being independent of the frequency. The loss of energy through hysteresis, and the magnetizing current for a given voltage, is smaller in proportion as the frequency is greater. The hysteresis increases with the increasing E. M. F. very closely to the 1.6 power of the frequency; the magnetizing current, on the other hand, increases at first considerably slower than the E. M. F., then changes its rate suddenly and grows very rapidly. For a frequency of 204.5, for instance, by doubling the E. M. F. from 50 to 100 volts, the magnetizing current increases from .8 to 1.12 ampere, that is, 40 per cent., while at a frequency of 36.3, by doubling the voltage from 27 to 54 volts, the magnetizing current increases from 1.5 to 24 amperes, or about 1,500 per cent. He gives very complete data in the form of curves, regarding a number of features of the transformer, and concludes that the efficiency of a given transformer, for decreasing loads, diminishes rapidly, the smaller the frequency. He states that the following may be considered as having been experimentally proved: That the loss of energy due to hysteresis is independent of the load and dependent only on the magnetization and the frequency. That the magnetic characteristic (the relation of the magnetism to the magneto-motive force or the magnetizing current) is constant and independent of the frequency. That the ohmic resistance and therefore the C^2R loss is for the frequency used in practice, the same for alternating as for direct currents; that is, the

current density is still practically equal in the whole section of the conductor. (For very large secondary currents and high frequencies copper strips are used for the secondary winding).

He then gives a comparatively simple mathematical discussion of the relation of the frequency to the output and efficiency. In this he assumes that the length and cross-section of the iron and copper circuits remain constant, but the number of windings varies to suit the best E. M. F. His conclusions are as follows: The coefficient of loss in a transformer is a minimum, and its output for a given internal loss a maximum, when the loss due to heating in the copper is equal to the loss through molecular friction in the iron. From this it follows that if the maximum output at different frequencies is to be compared, the current density in the copper and the product $N B^{1.6}$ must be constant, in which N is the frequency and B the maximum induction in the iron; that is, the number of lines of force per square centimetre. The magnetization for a maximum output must be inversely proportional to the five-eighth power of the frequency. The latter is applicable only within certain limits, as B should not exceed a certain maximum. From this he deduces the following: The maximum output of a transformer is proportional to the three-eighth power of the frequency when B has not reached its maximum value. It will be seen, therefore, that the maximum output of a transformer increases but slowly in relation to the frequency. He also concludes that: The ratio of loss (that is, the maximum allowable loss divided by the maximum output) is at its maximum inversely proportional to the three-eighth power of the frequency. The lower the frequency, therefore, the greater must be the magnetization in order that the transformer may work at its maximum rate; that is, in order that there may be the same loss in the iron as in the copper. As B is limited, a certain point is reached at decreasing frequencies, where the magnetization dare not be increased. Below this frequency the iron loss can no longer be made equal to half of the total loss; the current density may, however, be somewhat increased as the iron loss becomes smaller; the transformer can, however, no longer work at its maximum rate and the output and efficiency decrease rapidly. In this case he shows that the relation of the output and the frequency is quite different and approaches, by diminishing frequencies, to direct proportionality, while the coefficient of loss approaches inverse proportionality to the frequency. He gives curves for this transformer, showing its maximum output and the efficiency in per cent. as functions of the frequency. This curve shows that for a maximum loss of 50 watts and a maximum of B = 10,000 the change of curvature takes place at a frequency of about 60. By frequency in this article is meant complete periods per second.

Tools Driven by Motors.—The "Elek. Zeitschrift,' March 10, gives in full a paper by Mr. Richter on the advantages of driving tools in a factory by means of individual motors, instead of by means of belts and shafting. The paper is very well illustrated with 19 illustrations, most of them showing the various tools of a machine shop operated directly by an electric motor forming, in most cases, a part of the machine itself. In quite a number of cases working drawings are shown. Among the large illustrations are two, one of which shows a shop driven with belts and one driven with electric motors, showing the contrast. A number of the illustrations are well worth the attention of those engaged in the manufacture of lathes, drills, planers and machines of a like nature driven directly by electric motors.

ARC AND INCANDESCENT LAMPS.

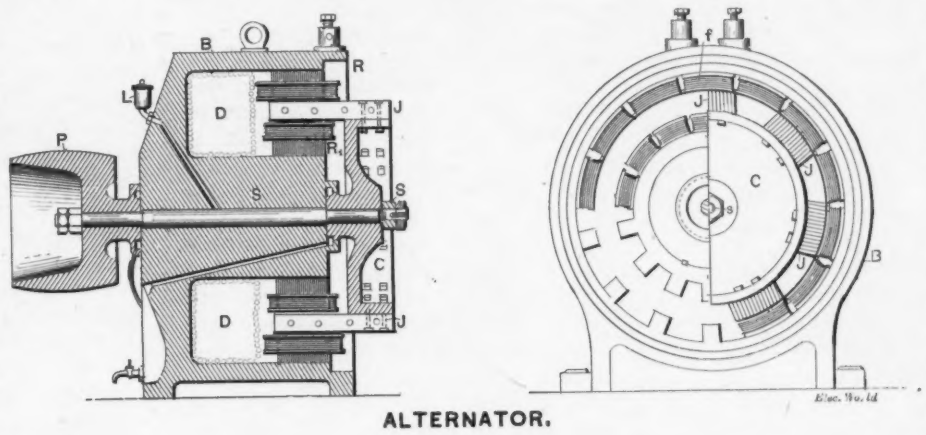
Relation of Candle Power, Voltage and Watts.—Messrs. Feldmann & Versteeg, in the "Elek. Zeitschrift," Feb. 3, give some very extended data from the results of their tests, made with incandescent lamps at very greatly differing voltages. One set of lamps was tested at 37 different voltages from 21 to 176 volts, the details of which are given in a table. The paper also contains curves giving the observed and the calculated candle power at different voltages, the amperes, the watts, and the watts per candle, all as functions of the voltage. Another curve shows the variation in the resistance. Another gives the candle power as a function of the voltage, first for increasing voltages and then for decreasing voltages, which are, however, of less interest. For the Zurich lamps they deduced the following formulas:

$$\text{Candle power} = 2.64 \times 10_{-13} (\text{volts})^{6.8}$$
$$\text{Candle power} = 6.56 \times 10^{-5} (\text{watts})^{3}$$
$$\text{Watts per candle} = \frac{4\,88 \times 10^{9}}{(\text{volts})^{4.8}}$$

Similar formulas were found for quite a number of other lamps, all of which are given in that paper; the formulas for the watts all contain the watts in the third power, but the constant in the equations as well as the exponents for the voltage differ quite materially from each other, so much so that a mean would have very little value.

Arc Lights.—In running arc lights on constant potential circuits it is customary to introduce a dead resistance; Mr. Zacharias, in the "Elek. Anzeiger," Nos. 12 and 13, discusses at some length the suggestion that incandescent lights might be used in place of this dead resistance. He calculates a number of cases and shows that great economy can be gained thereby. This application is, of course, limited, but there are, nevertheless, many instances, as in stores, restaurants, side streets in street lighting, etc., where the incandescent lamps would burn only when the arc lamps are burning. In such a system an automatic apparatus is required to protect the incandescent lamps from injury. This apparatus is described in the article.

Lighting by Phosphorescent Tubes.—An article in the Lond. "Elec. Eng.," March 10, partly in the nature of a trade notice, describes some of the results obtained by Messrs. Pyke and Harris, together with Sir David Salomons, with phosphorescent tubes, which it is stated are now being introduced for practical lighting in England in places where beauty is of more importance than a very brilliant illumination. The generator used is of comparatively simple construction, and is shown in the accompanying cuts of a 6 kilowatt machine, which will explain themselves. D is the field magnet coil; R R are laminated rings with polar projections on which are placed the armature coils; J J are pieces of laminated iron which rotate between the poles; there is no moving wire, and in case of failure of one or several coils they can be cut out. One form of vacuum tube, from which good results are said to be obtained, is made of a spiral of a thin glass tube, the ends of which are connected to two bulbs which contain the electrodes; when made phosphorescent by the current the coil gives out a fairly brilliant, cool light, and uses, it is calculated, about 1 watt per foot of tube lighted. The objection to these tubes is that when brilliantly phosphoresced they become heated and the glass is apt to melt. The light is never very brilliant, not sufficiently so to replace ordinary incandescent lamps, though where a soft moonlight effect is desired they are said to produce very pleasing effects. From 50,000 to 100,000 volts are required for the vacuum tubes; this is obtained by means of a transformer in oil. The tubes are lighted by induction effects, and it is stated that they are connected in series with condensers connected in parallel. To properly light a tube of one inch internal diameter one square foot of tinfoil condenser is required; tubes of 1-16th of an inch diameter, the size usually used, require condenser sheets ¾ of an inch square. Only tubes of the same kind can be placed in series, enough to make a total of one foot of tube. They make a small closed circuit transformer adapted to be attached to any alternating current mains, which will raise the potential from 100 to 5,000 volts; it is capable of being sold for $5. It is made by winding three primary circuits of No. 22 wire, one at each end and one at the middle, over boxwood bobbins, with the secondary of No. 40 wire in between; the whole is then wound longitudinally over and over with fine iron wire until the secondary core is filled; the whole is then suitably covered with velvet or other decorative material. They are arranged so as to hang in place of a lamp, on a bracket or chandelier; the vacuum tube lamp is attached directly to the transformer, which is said to use only ½ an ampere at 100 volts. (Unfortunately no data of the candle power of the light are given, and it is, therefore, probably quite low.)



ALTERNATOR.

RAILWAYS.

The "Elek. Rundschau," No. 11, contains an illustrated description of the trolley line at Marseilles, including an illustration of the Oerlikon motor.

CENTRAL STATIONS.

The Lond. "Elec. Eng.," March 3, gives a summary of the electric lighting schemes proposed for the city of Strassburg prepared by Mr. von Miller. It includes four different proposals, one for alternating current with steam power, one for continuous current and batteries with steam power, one for each of these two, using water power with steam reserve. It gives a detailed statement of the costs and other data for each of the four proposals, which are worth the attention of those interested in this subject.

The Lond. "Elec. Eng.," March 10, begins a description of the Paddington Central Station, which includes an illustration of the large Kapp alternator. It also gives a report of experts on the proposed lighting of the Ealing District.

WIRES, WIRING AND CONDUITS.

Free Wiring.—Mr. de Segundo, in the Lond. "Elec. Rev.," discusses the article on free wiring, published in The Electrical World, Feb. 4. After reviewing the subject, he suggests that the following system might be introduced with advantage in rented houses; that the landlord pay for installing the wires and the tenant agree to pay a higher rent of, say, 15 per cent. per year on the landlord's outlay to cover depreciation and interest; that the tenant may exercise his option to bear the cost of wiring himself or that the supply company apply part of its capital for this purpose, the tenant agreeing to pay a fair rent and the landlord agreeing to pay interest at, say, 5 per cent. per year on the company's outlay, while the house is uninhabited, the landlord reserving the right to take over the wiring from the supply company at a fair valuation, at any time.

Concentric Cable Phenomena in Alternate Current Mains.—In an article in the Lond. "Electrician." March 10, Mr. Neustadt states that in a large network of concentric cables, the insulation will often be destroyed when a section of cable is switched in or out, while the current was on, or if a cable fuse is blown; in most cases the damage was done to the insulation between the outer conductor and the sheath The puncture occurred only when the inner conductor was coupled first, or when the outer conductor was first disconnected, and when the section in question contained transformers having open or lightly loaded secondary circuits. He then gives a theoretical discussion of the cause of this phenomena. He illustrates his final formula by calculating from it a special case in which he finds that the original 2,000 volts may rise to 5,300 and 5,390, assuming the currents to follow the sine law; a departure from this law may cause a much higher rise of volts. To avoid this increase in the voltage, a rule should be made that the inner conductor must never remain coupled alone; switching arrangments ought to be constructed so as to make a mistake impossible.

ELECTRO-CHEMISTRY.

Copper Tube Works.—The Lond. "Electrician," March 10, gives a description, by Mr. Feldmann, of the large water power factory installed near Cologne for making copper tubes according to the Elmore process. The article is accompanied by a plan, elevation and interior view of the factory. There are 200 tanks, corresponding to an output of 35 tons a week, of which 40 tanks are at present in use. In some of these, tubes of 10 feet 8 inches in length and 22 inches in diameter are produced; all the tanks are connected in series. By the same process they also thicken calico rollers; they also have developed another branch, in the coating of seamless wrought iron tubes, which are first turned true and then covered with copper up to one-half inch; such rollers are mostly employed in paper and textile machines; tubes for use in mining, coated inside and outside with copper to prevent oxidation, are also made by this process.

Lead Plating.—According to a process described in the "Elek. Anzeiger," the articles are first cleaned in a bath containing 10 per cent. hydrochloric acid and 1 per cent. hydrofluoric acid, heated to 50 degrees C., contained in a lead-lined vessel. A current is passed through them, the articles forming the anode and the lead vessel the cathode; care must be taken to have the proper current density (but no figures are given). They are then immediately plunged into a bath of lime water of the same temperature, and then in a bath containing an equal part of tin and zinc dissolved in hydrochloric acid; this prepares them for the lead bath; they are then plunged into a bath containing molten lead. It is claimed to be better to cover iron wire with lead in this manner than with zinc by the usual process of galvanizing, because the lead is more pliable, and as it does not alloy with the iron it does not make it brittle, as in the galvanizing process. (It should be remembered, however, that there is no true galvanic protection of the iron when covered with lead; in the presence of moisture, if the iron is at all exposed, the action of the lead will be to facilitate rusting, due to the electrical current produced, while with zinc the current is in the opposite direction, which tends to keep the iron bright at the expense of the zinc.)

Primary Batteries.—Mr. Noellner, in Germany, states that the addition of ordinary sugar in the usual Leclanche batteries will render the crystals, which usually form on the zinc, soluble, and that the zinc will, therefore, remain quite clean. (If this is true, it certainly is an important improvement and is all the more valuable because of its simplicity. The same thing is said to be arrived at by the addition of chloride of zinc; but if sugar answers the purpose as well, it is, of course, preferable.)

In the Lond. "Elec. Rev." Mr. Muras gives some data regarding the heating of chromic acid and Grove cells during discharge, the practical value of which is not apparent, except to show that the increase of current, after starting, is probably due to the diminution in the resistances of the liquid owing to its rise in temperature.

A French firm makes a transformer in the form of a

small Ruhmkorff coil constructed to give about 120 to 150 volts in the secondary, the primary current being obtained from a few primary batteries; it is suggested to be used for photographers and lecturers. A single large dry primary cell giving a large current could easily have its current transformed by this means up to 60 volts, sufficient for an arc lamp.

MISCELLANEOUS.

Welding.—"L'Elec.," March 4, describes the system of welding by means of the arc known as the Combs-Wood method. It is used chiefly for welding tubes, and is said to be quite successful. The arc in this method is passed rapidly over the surface to be heated, thus distributing its heat over a sufficiently large surface to avoid injurious concentration of the heat and burning; for thick pieces several arcs are used at the same time. To a combination of these two principles the success is said to be due. In an installation in England three dynamos are used giving 150, 200 and 300 amperes at about 145 volts; these charge Plante accumulators from which the welding current is taken; the accumulators are so proportioned that the welding current is not too large for them. Great care must be taken to protect the eyes and hands of the workmen, as arcs of 300 to 500 amperes may produce very injurious effects. The length of the arc is from ¼ to ⅜ of an inch; long arcs are preferred as they are not so apt to become extinguished; the positive pole is connected to the piece to be welded and the negative to the carbon, after passing through rheostats made of bands of iron which can be varied to regulate the arc, and thereby the amount of heat; the carbons which soon become hot are cooled by plunging them into water. The method is used in practice for a number of special purposes which are illustrated in that article. Among them is the manufacture of iron cylinders for high pressure made of a tube capped at both ends. The joints to be welded are heated in the arc and then hammered. In making lap-welded tubes an electric motor is used which gives the carbon a rotating motion, and at the same time, a longitudinal motion so as to distribute the heat over the part to be welded, gradually traveling along the whole length of the tube; after heating to a welding temperature the tube is drawn through a die and hammered. This company formerly used gas for heating, but now prefers the electrical method. Another operation is to make T joints of tubes; the hole in the tube is made with the arc by melting the metal, instead of by boring and cutting; the flange is turned up after heating it in the arc; for a tube about ¼ of an inch thick and 5 inches in diameter the heating is accomplished in 5 minutes by means of 3 arcs traveling over the surface. Very complicated weldings may be made in this way, many of which it is impossible to make in any other way. Very thick pieces, too thick to be heated to a welding heat throughout, are joined by filling the joint with metal melted in the arc; as the strength of this metal is not so great, notwithstanding hammering, the joint is made correspondingly larger. The article contains the results of a series of tests made with bars welded in the electric arc and afterward tested for strength; the diminution in strength varies considerably, depending on the skill of the workmen; in some cases it was very little, while in others it varied up to 20 and 30%; the elongation is very much reduced.

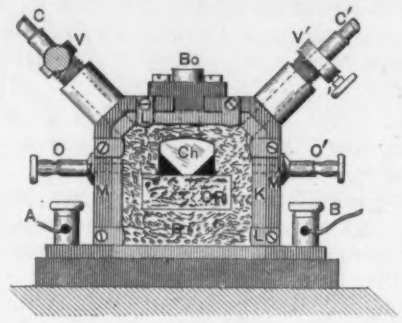
Ozone.—Mr. Slater, in the Lond. "Elec. Rev.," in commenting on the destruction of insects and germs by means of ozone, states that while it is very desirable to kill disease germs, it would be very undesirable to, at the same time, destroy the bacteria which transformed the nitrogen of dead animals and plants into nitric acid and ammonia, and those which enabled the roots of leguminous plants to utilize the nitrogen of the air; nor would the expulsion of earth worms be at all advisable. The question is of sufficient importance to deserve the study of entomologists and bacteriologists.

Liquefaction of Ozone.—The Lond. "Elec. Rev." in a short paragraph on this subject states that ozone is a little less easily liquefied than carbon dioxide. The mixture of oxygen and ozone must be cool when compressed or else heat is generated, followed by a violent explosion. Berthelot gives the heat of formation of ozone as 14.8 calorics. Messrs. Hautefeuille and Chappius, in attempting to liquefy ozone, find that at 200 atmospheres pressure and —88° C. the color was a deep blue, but the gas was not liquefied. By adding considerable carbon dioxide a blue liquid was obtained at —23° C.; this liquid was permanent at that pressure and was a solution of ozone in liquid carbon dioxide. In a mixture of oxygen and ozone at 125 atmospheres, the ozone appeared in drops of a deep indigo color, which liquid was preserved for more than a half hour at 75 atmospheres pressure.

Incinerators.—The "Indian Engineer" states that one pound of straw burnt in a suitable furnace yields four pounds of steam, and, on the assumption that the refuse of cities has one-eighth of the calorific power of straw, the combustion of one ton of refuse should produce nearly 18 h. p. per 24 hours.

Solder for Aluminium.—Mr. Rader gives the following solder, which can be used for a number of metals, but is specially adapted for aluminium: Cadmium 50, zinc 20, tin 30. The zinc is first melted, the cadmium is then added and afterward the tin; it must be well heated and stirred.

Electric Furnace.—The accompanying illustration shows the electric furnace of Moissan, mentioned before in these columns, as made by a French firm. CR is the crucible, which is made of a highly refractory substance and which can be withdrawn from its refractory casing R. Ch is an open space above the arc; O O^1 are apertures for introducing and circulating gases; Bo is an opening



ELECTRIC FURNACE.

for the introduction of the material; C C^1 are the carbons; the back and front are closed by mica sheets which can be removed; the rest of the construction will explain itself. The apparatus may be placed between the poles of a magnet, which acts on the arc, making it many times longer and making it a real electric blowpipe, which can be directed at will by varying the position of the magnet. With this apparatus Mr. Joly has succeeded in obtaining metallic ruthenium.

Mr. Fred H. Sargent: A Brief Review of His Work.

Much regret is expressed on all sides over the resignation of Mr. Frederick Sargent, and especially so among the members of his own department. Mr. Sargent was one of the first men connected with the Bureau of Construction, having been engaged under the original organization, as electrical engineer. Having carried the work through from its first inception almost to completion, it is to be deplored that differences should arise at this time which should cause his resignation.

Mr. Sargent began work with the Exposition in April, 1891. At the outset he showed a remarkable perception of the problems to be encountered, and proceeded with great vigor to the solution of those which fell directly upon him. The summer and fall of 1891 were devoted mainly to the discussion of the most general schemes for the arrangement of the power plant, the distribution of lights and the transmission of electricity and other sources of power, and also to the erection of the temporary power and lighting station, which was started in the latter part of October, 1891, and is still in service, though it will be taken out before this month is passed.

It was not until the winter of 1891-92 that much work for the permanent installation was done. Bids were received in February, 1892, for the dynamos, wire, etc., for arc and incandescent lights and for power circuits; and shortly after this figures were taken for fuel and boilers. Mr. Sargent, at this point, displayed unusual tact and executive ability in the treatment of the various propositions received, in the negotiations for the incandescent light plant, in the distribution of the arc light contracts and in the harmonizing of rival factions in adjusting the boiler contracts.

The resignation in March, 1892, of Mr. Slocum, who had previously been the mechanical engineer, left Mr. Sargent in entire charge of the Mechanical and Electrical Departments. Work on the plans for the final arrangement of the power plant and lighting systems was scarcely begun before May, 1892, and work on the installation of wire ducts and the construction of engine foundations a month or so later. In the arrangement of the plant a great difficulty arose from the fact that the engines, pumps and such machinery for use in the plant were to be taken from exhibits offered free of cost. The necessity of using the engines at hand, the difficulty of obtaining the kind desired for a particular location, or of additional ones when required, and the satisfying of many different exhibitors added much to the natural difficulties of the problem.

The general scheme of the plant and the distribution of lights was not even complete in arrangement until October, and many additions have been made since then and many of the details are being now worked over.

The work has required the most constant and self-sacrificing interest on the part of Mr. Sargent. Day and night he has devoted himself to meetings with department chiefs, discussion of schemes for lighting, and the adjustment of conflicting interests, the procuring of machinery, the awarding of contracts; all this and more added to the responsibility for an endless amount of detail in the matters of design, construction and operation, has exacted the most diligent and painstaking care and forethought and the greatest energy.

The design and much of the construction of the Exposition electric and power plant will always reflect to the credit of Mr. Sargent.

There seems to be no unpleasant feeling whatever between Mr. Sargent and the other members of the Construction Bureau or the Council. Mr. Sargent, on his part, feels relieved of a very great strain, and will now devote himself to his private work. He has already been engaged as the consulting engineer of the new Edison central station in Chicago, which is to be the largest electric light station in the world.

NEW BOOK.

ELECTRICAL PAPERS. By Oliver Heaviside. Two vols. London: Macmillan & Co., 1892. 560 and 587 pages. Price, $10.

These two volumes are undoubtedly the most important contribution to electrical science since the publication of Maxwell's great work and only comparable in value to the latter, Thomson's Papers on Electrostatics and Faraday's Researches. While Heaviside has been recognized by the few acquainted with his work as a worthy successor to the great Maxwell, his writings have been so scattered and difficult of access that he has hitherto not received the general recognition that will now be undoubtedly accorded.

The papers are arranged as far as possible in chronological order, and include several not heretofore published. They are reprinted with only minor changes and "the scientific reader may therefore refer to this work as to the original papers."

The first twelve articles are on matters dealing mainly with telegraphing and but loosely connected, but continuity begins with the succeeding ones, eight in number, which deal mainly with the theory of the propagation of variations of currents along wires, with extensions to include self-induction and the mutual influence, both electrostatic and magnetic, of parallel conductors. This section is a stepping stone to later ones in which the theories here introduced are carried to their full consequence.

Next in order is a series of papers contributed to the "London Electrician" relating to electrical theory in general, which is prefaced by a valuable introduction to the Victor system of mathematics employed by the author, further explanations of the same running through the first part of the series; the final development of this mathematical machinery is given in the first and last parts respectively of volume II. The first section ends with the theory of the propagation of induction and the electric current in round cores in which the author begins to introduce the theories that are developed later. The concluding section of this series on electromagnetic induction and its propagation is the beginning of a systematic development of the author's theories that is carried throughout the rest of the work. It is well here to remark that the author modestly denominates his work and theories as merely extensions of those of Maxwell, which, however, should be taken in the same sense as Maxwell's similar acknowledgment to Faraday.

Articles on electric and magnetic stresses precede a lengthy treatise on the self-induction of wires and the work is appropriately concluded by the very important papers on the electromagnetic waves, and a discussion of the forces and stresses concerned in the electromagnetic field.

Sandwiched between the more important papers are minor ones relating to special and practical applications and rather personal and often amusing controversies. Scattered throughout the work are practical deductions of great practical value, and notably a number of equations enabling the ohmic resistance, inductance—and drop due to impedance of difference conductors, including concentric ones, to be calculated. These are much more general than those of Lord Kelvin and Lord Rayleigh, and in a more convenient shape for calculation.

It is greatly to be desired that the author will supplement his great work by a systematic treatise that will place his method of treatment and theories within the grasp of the vast majority who are unable to follow them connectedly in their present form. With the growth of alternating currents and high potentials and frequencies the theory becomes essential which makes the surrounding medium the prime factor in accounting for electrical phenomena, and it is none too soon to introduce the ideas of wave propagation that are displacing the older theories so rapidly in the upper circles of science.

The preface is characteristic of the author, and the body of the work would be more dignified if he had confined his personality to that alone. The singular propensity of the new school of English scientists, of which Doctors Heaviside and Lodge are representatives, to mar their scientific writings by a facetiousness entirely out of place is probably not appreciated beyond the circle of their immediate friends.

Many articles in the work contain no mathematics, and in a number of the important ones that do, the statement of the theories that are afterward mathematically developed can be followed by the non-mathematical reader. In this respect it has the advantage of Maxwell's work, and consequently can be recommended to every one who takes an interest in this line of work.

A Plea for Abbreviations and Greater Distinctiveness in Electrical Terms.*

BY W. E. AYRTON.

The President: Before calling on Prof. Fleming to favor us with his reply to the discussion which his paper has given rise to, I will ask Prof. Ayrton to give us some remarks which I understand he would like to make upon the subject.

It was only a few minutes ago that I was informed by the President that I had to speak this evening on Dr. Fleming's paper. When that paper was read, I made a number of marginal notes on the proof of good things which I intended to say; but I did not bring that proof this evening, as I had no idea that the discussion on this paper was to be continued. However, in obedience to the President's request, I will say something, even if it be not the something which I had intended to say.

Dr. Fleming throughout his paper has used the abbreviations "ammeter" and "P. D.," and, by thus winning the heart of their proposer, has almost disarmed criticism on my part. By the bye, I noticed the other day that the expression "P. D." was called slang in the "Electrician." I suppose "Salisbury Court, E. C.," would be also slang, I thought of writing to say so, but remembering that my signature, "W. E. Ayrton," would also be slang, I refrained from doing so.

The use of initial letters as abbreviations such as "A. D." for anno domini, "P. S." for post scriptum, etc., are, of course, not slang. Neither, therefore, is the employment of "P. D." for potential difference. So that, emboldened by the success that my former suggested abbreviations have met with, I will now propose another, to enable the objectionable expressions "effective current" and "virtual current" to be dispensed with.

What should be called the effective current clearly should depend on what is the effect you desire to produce. A direct current, such as that produced by a Brush or a Thomson-Houston dynamo, can, of course, be used for electro-deposition although the current periodically varies in strength. But the metal deposited in a given time in an electrolytic bath depends on the mean current, as measured by a D'Arsonval galvanometer, and not on the square root of the mean square, as measured by a dynamometer, or by an ammeter with a soft iron needle. In this case, then, the mean current ought to be called the effective current. But the same current can be employed to make a glow lamp incandesce, and in that case the effective current is the square root of the mean square. And, lastly, if a condenser be placed as a shunt to the machine there will be a small alternating current through the condenser, the effective P. D. for producing which is neither the mean P. D. at the terminals of the dynamo, nor the square root of the mean square, but the rate of variation of the terminal P. D.

Again, "virtual current" means a current, I presume, virtually equivalent to something else, and is virtually as bad and no more effective than the expression "effective current."

With all due deference to the Paris Congress, I, therefore, propose that the words "effective" and "virtual" should be dropped, and that for abbreviation the mean current should be called the "M. current," the mean square the "M. S. current," and the square root of the mean square the "R. M. S. current." A D'Arsonval galvanometer then reads the "M. current." As regards the "M. S. current" and the "R. M. S. current," I have had two scales attached to Siemens dynamometers in my laboratory. With the outer, the "M. S. current" can be at once read off in amperes squared, and with the inner the "R. M. S. current" in amperes. And I may mention that in drawing these scales attention has been given to the variation of the constant in different parts of the scale of a Siemens dynamometer, to which Prof. Perry and I drew attention some years ago at the Physical Society, and which arises from a distortion of the spring, which occurs even for so small a deflection as 180 degrees.

While on the subject of dynamometers I may mention that I was very glad to hear that Dr. Fleming had found so useful the method that Dr. Sumpner and I suggested for diminishing the self-induction error with a wattmeter. This method, which was given in one of the few of our Physical Society's papers that was written, and therefore published,† consisted in replacing the many-convolution fine-wire coil of a wattmeter, and its accompanying stationary non-inductive high resistance, by a few turns of thick wire and an auxiliary low resistance of thick wire—by using, in fact, an ordinary dynamometer as a wattmeter with a low-resistance pressure coil. No doubt in this way you waste a great deal more power in making your measurement; but if you are anxious to obtain a perfectly accurate result, the waste of power in the wattmeter itself is quite unimportant compared with the accuracy obtainable. This waste of power does not enter into the measurement; it merely means that the dynamo has to do a little more work.

As to the construction of electrostatic voltmeters, I have already explained at a meeting of the Institution of Civil Engineers why I think that the employment of flat needles is a mistake. Mr. Mather and I propose shortly to offer a paper to this society on the theory of the design of electrostatic measuring instruments, and I will, therefore, now do no more than say that while Prof. Fleming has only succeeded in reading to an accuracy of ½ per cent. when using a reflecting zero Swinburne electrostatic voltmeter, we find that without a mirror, and without the necessity of any zero adjustment, it is comparatively easy to read to 1-10th per cent. on the working part of the scale with a simple inspectional electrostatic voltmeter properly constructed.

On the last occasion fun was poked at professors, and at their Hampton-Court-Mazy ways of testing transformers; but had Mr. Swinburne condescended to use the three-voltmeter method for measuring power he would neither have sent out transformers with a far greater iron loss than he stated that they possessed, nor would he have constructed, and used, a wattmeter which read wrongly when used to test "hedgehog" transformers, in consequence, as Dr. Sumpner has proved, of Foucault currents being generated in the brass supporting rods of the wattmeter coils.

When publishing the three-voltmeter method it was not the intention of Dr. Sumpner and myself that it should always be employed whenever the power given by an alternating current to a circuit had to be measured; but we regarded its use as we regard the use of a Kelvin balance for measuring current. I should, for example, not think of measuring every current commercially by means of a Kelvin balance—it would be too troublesome and lengthy a process; but, if I had doubts about the accuracy of the readings of an alternate-current ammeter, I should check them by comparing the ammeter with the Kelvin balance. So, in the same way, before pronouncing the readings of a wattmeter correct, and before trusting to any important results that this wattmeter might appear to bring out when employed to measure a very inductive load, I should check the wattmeter by means of our three-voltmeter method.

And although Dr. Fleming has made a large number of experiments, some of which show what, it is to be observed, our formula published on page 609 of his paper shows equally well, without the necessity of making a series of experiments—viz., that when the lag is great an error in reading the voltmeter produces a serious error in the measurement of power by the three-voltmeter method—he has, as he has himself written to me, "relied, as a last resource, on the carefully performed three-voltmeter method as a Court of Appeal."

The experiments that Dr. Fleming has so carefully carried out have confirmed the results of the tests that were published last summer by Dr. Sumpner and myself at the meeting of the British Association, in Edinburgh. Then we stated that our tests "show that neither at no load nor at full load is there any great difference apparently between the power wasted in a 'hedgehog' and in a Mordey type of transformer of the same output." Tables of results of tests of the closed magnetic circuit type of transformer at different frequencies were given in that communication; and in a paper published in the "Electrician" for Nov. 25, of last year, we gave the results of further tests of a "hedgehog" and of a Mordey type of transformer, which showed that the iron and copper losses in the former were each respectively greater than the iron and copper losses in the latter.

Mr. Swinburne has therefore undoubtedly made a mistake; but you know the adage, "He who never made a mistake never made anything else." Now, I venture to think Mr. Swinburne has done so much to advance our knowledge of alternate current working that he is almost justified in making a mistake.

Dr. Fleming has coupled the methods of testing transformers employed by Dr. Hopkinson and by Dr. Sumpner and myself. They have, no doubt, this in common: That with both methods the loss of power is directly measured instead of being deduced from the difference of two nearly equal quantities—the power put into the transformer, and the power put out. But there is this most important difference—that, while Dr. Hopkinson's analytical method can only be employed in a laboratory with fairly delicate apparatus, the plan of testing employed at the Central Institution is essentially a workshop one, as nothing is required beyond ordinary workshop measuring. It is important to notice that, because people might be led to think, from the way in which the method is referred to in Dr. Fleming's paper, that it was very difficult to use the method we have been employing at the Central Institution. It requires, undoubtedly, two transformers, but those two transformers need not be even of the same type. Indeed, all the tests that we made on the "hedgehog" transformer, using this method, were not carried out with two "hedgehog" transformers, but were made with a "hedgehog" transformer combined with a Mordey type of closed magnetic circuit transformer, showing that the method can be employed with success even when the two transformers differ so radically in type as do an open magnetic circuit transformer and a closed magnetic circuit transformer.

Our method further not only saves power and enables a large transformer to be tested with a small alternator, but it gives the magnitudes of the iron and of the copper losses directly and separately by the respective readings of two wattmeters without any calculation whatever. That Dr. Sumpner's method is essentially a workshop method is best proved by Mr. Mordey having already adopted it for regular use in the works of the Brush Electrical Engineering Company.

* From advanced proofs of a discussion of Prof. Fleming's paper before the Institution of Electrical Engineers, Jan. 26.

† "Alternate Current and Potential Difference Analogies in the Methods of Measuring Power," Phil. Mag., p. 212, August 1891.

Electric Motors Operating on Single Phase Alternating Current Circuits.

BY ELIAS E. RIES AND GORDON J. SCOTT.

In view of the discussion that has recently taken place in reference to alternating current motors, both on this and the other side of the water, we desire to announce through the columns of the electrical press that for the last year and a half we have given a great deal of attention to the question of power transmission by the use of commercial alternating circuits now in use. The subject has been dealt with on circuits, the frequency of which varied all the way from 200 to 40 cycles per second. Some very interesting and useful facts have come to light, and our experiments have shown that practical alternating current motors of any size can be built and operated at the ordinary frequency of 138 cycles per second, or even at higher frequencies, with a commercial efficiency equal to any direct current motor.

This has been fully demonstrated by experiments made upon a motor in the factory of the Ries Electric Specialty Company, which develops nearly 2 h. p. at the slow speed of 360 revolutions per minute. The total weight of this motor is just 64 pounds; there are only two pounds of copper on the machine, and it shows a commercial efficiency of 85 per cent. when run upon an ordinary incandescent lighting circuit of 50 volts at a frequency of 138 cycles per second.

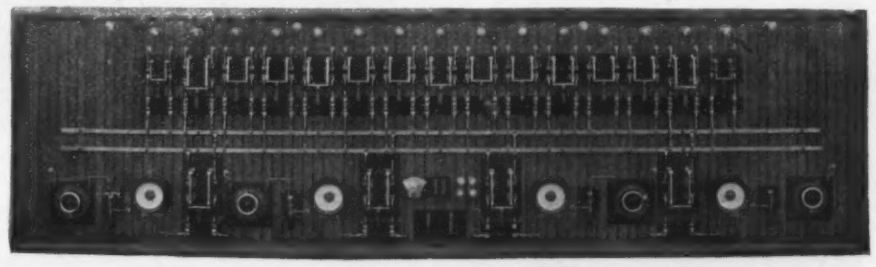
The motor referred to is built upon entirely new lines and is radically different from any of the types of alternating motors so far described. The motor operates without the use of condensers, reaction devices, secondary batteries or similar paraphernalia for changing the lag or phase. We intend to turn out in a short time, in addition to this type, an entirely new and novel single phase motor of high efficiency, having a completely closed magnetic circuit, and, as a consequence, a very small magnetizing force.

For electric railway work we have a special form of this motor under way, which will have a variable speed with a maximum torque—a feature that has not heretofore been possible, either with direct or alternating current motors, although numerous attempts have been made by various well known inventors to produce this desirable result in direct current practice by the use of motor generators, differential gearing and other equally complicated devices. The Ries & Scott railway motor of this type will be of 20 h. p. and will weigh when completed about 600 pounds, which is less than one-half the weight of direct current railway motors, thus combining great starting effort with low consumption of energy and with very light weight.

Owing to patents pending we cannot enter into fuller details at present, but can state that we will, in a few months, place upon the market a reliable and self-starting, synchronous or non-synchronous alternating current motor, fully equal, if not superior to any direct current motor that has been built. This motor will not only solve the difficulty that has thus far been encountered in utilizing single-phase alternating currents for operating stationary motors of all powers, but will also render it commercially possible to employ the alternating current for electric railway work on a scale that will render the system, for economy in transmission and regulation, to say nothing of the increased safety and freedom from repairs, far superior to the direct current electric railway practice of to-day.

A Handsome Switchboard.

The accompanying illustration shows a very handsome switchboard recently installed in the House of Refuge, Glen Mills, Pa., by the Arnold Electric Manufacturing Company, of Chester, Pa. The board is 18 feet long by 5 feet high, made of 2½-inch quartered oak panels. A Weston voltmeter is located in the centre of the board



A HANDSOME SWITCHBOARD.

connected to six different centres of distribution and ground detector. On either side is located the main circuit switch, main line cut-out, ampere meter, field switch and rheostat for two dynamos. The switchboard receives the current from three 350-ampere generators through four main line switches and two copper bus bars; from these bars the current is distributed through double pole fuses and jack-knife switches into 15 circuits, varying from 50 to 250 amperes each. There are two rows of lamps above the switches, the lower one of which is connected to their respective circuits, and indicate if the current is being fed to that circuit; the upper row contains four lamps, which are connected to the dynamos before the current reaches the switches, so that in case of a complete blow, these lamps will light the board so that it can be re-fused.

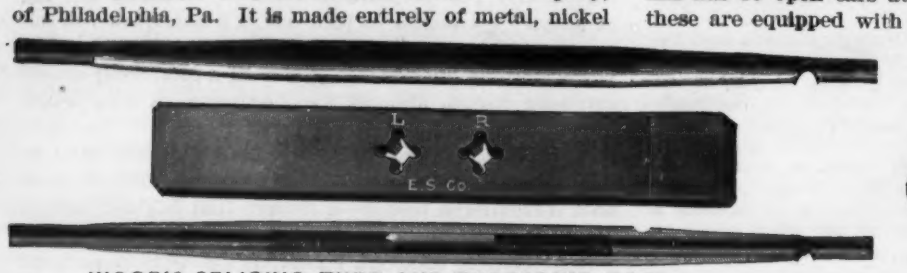
Wood's Splicing Tube and Threading Tool.

The accompanying cut illustrates the splicing tube manufactured by the Ansonia Electric Company (formerly the Electrical Supply Company), corner Randolph and Michigan avenue, Chicago. The connector is made in one piece, threaded on the inside with a right and left hand thread. With the aid of a threading tool, furnished for threading the wire, this splicer can be adjusted to the trolley wire in a very few minutes. These trolley splicers have been in use for more than a year, and have been indorsed by all electric roads using them. The splicer can be furnished with slots cut in it to admit of soldering, but this is not necessary, as the breaking strain without the use of the solder is 3,000 pounds. With

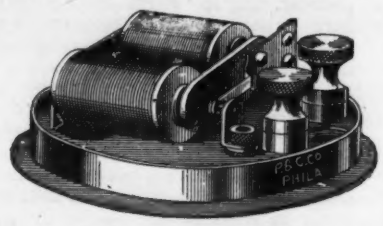
the addition of the solder it will stand a strain of 4,550 pounds without affecting the threads inside, according to a test made by the Chicago City Railway Company, the strain having broken the trolley wire without doing any damage to the splicer, or even stripping a thread. It constitutes practically a continuous wire and causes no sparking or flashing as the trolley wheel passes.

Partrick & Carter Co.'s Pocket Buzzer.

In the accompanying illustration is shown a pocket buzzer manufactured by the Partrick & Carter Company, of Philadelphia, Pa. It is made entirely of metal, nickel plated, and is of handsome appearance. It gives a clear, loud and pleasant sound, and will answer in many places where large buzzers are used. It also serves as a convenient and reliable circuit tester, and should prove indispensable to bell fitters and wiremen. The cut shows the buzzer with the nickel plated cap or cover removed.



WOOD'S SPLICING TUBE AND THREADING TOOL.



POCKET BUZZER.

The Peckham Truck.

There are many who are not aware to what an extent the trolley system has already been introduced in New York City. In fact, it is probable that the majority of the readers of the daily papers are scarcely aware that it has even secured a foothold here yet. They would be, therefore, very much surprised on going to the upper end of the city to find four roads already fully equipped electrically, in a manner fully up to the times in every respect. The roads referred to—all starting from 129th street and Third avenue—extend, the first to Fordham, via Third avenue; the second, to West Farms, via Third and Boston avenues; the third, to South Boulevard, via Third and Westchester avenues, and the fourth, to Port Morris, via Third avenue, South Boulevard, Lincoln avenue and 138th street. These roads are especially interesting for many reasons. First, for the manner of suspending the trolley wires in inverted troughs beneath the elevated roads; second, by reason of the methods adopted to make electrical connections at the drawbridges, and, third, on account of the carefully laid roadbed, which is one of the best in the country. In keeping with the permanent structure the Union Railway Company, which operates all these branches, has equipped its cars with the latest improvements that the market affords. At present it is operating 45 closed cars, about 13 miles of double track, and has 30 open cars at hand for summer use. All of these are equipped with Peckham trucks, manufactured by the Peckham Motor Truck and Wheel Company, Kingston, N. Y., and Thomson-Houston motors. A photograph of one of the closed cars with the latest type of Peckham truck is shown herewith. The satisfaction which these trucks gave when first introduced has led to their adoption on all the new extensions of the line, and the original order has been followed by numerous others, as the equipments have increased. The cars are heated by electric heaters, and lighted, of course, with incandescent lamps. The motive power is furnished by four 300-kw. generators, driven by Cooper-Corliss engines, supplied with steam from Babcock & Wilcox boilers. The present shops of the company are between 169th and 174th streets. The new shops and car house, in course of construction, are located on Boston avenue, corner of Woodruff avenue, and contain room for 180 cars, elevators, machine shops, carpenter, blacksmith and paint shops. They are heated throughout by steam and lighted by electricity.

FIG. 1.—CAR MOUNTED ON PECKHAM TRUCK.

The combination of excellent roadway with the new pattern Peckham truck make a trip through the suburbs over these lines a particularly pleasant one, since the motion is easy and free from jars and vibrations, and the usual noise is as nearly as possible obliterated.

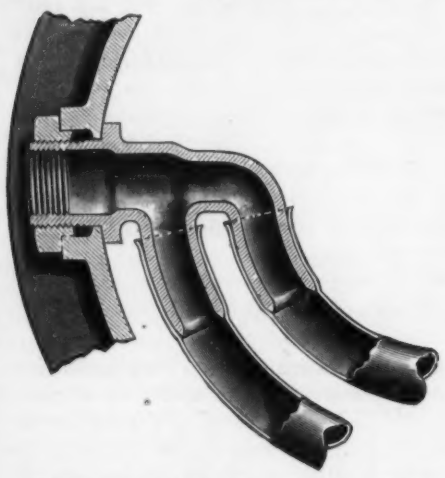


FIG. 1.—AMERICAN FEED WATER HEATER.

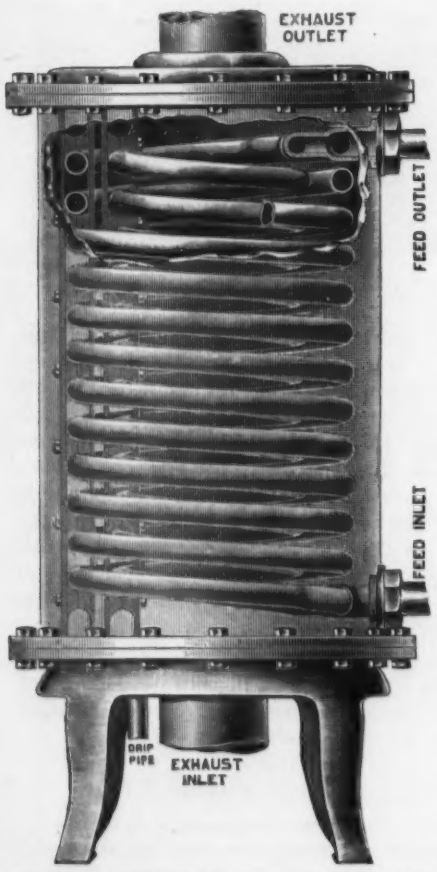


FIG. 2.—AMERICAN FEED WATER HEATER.

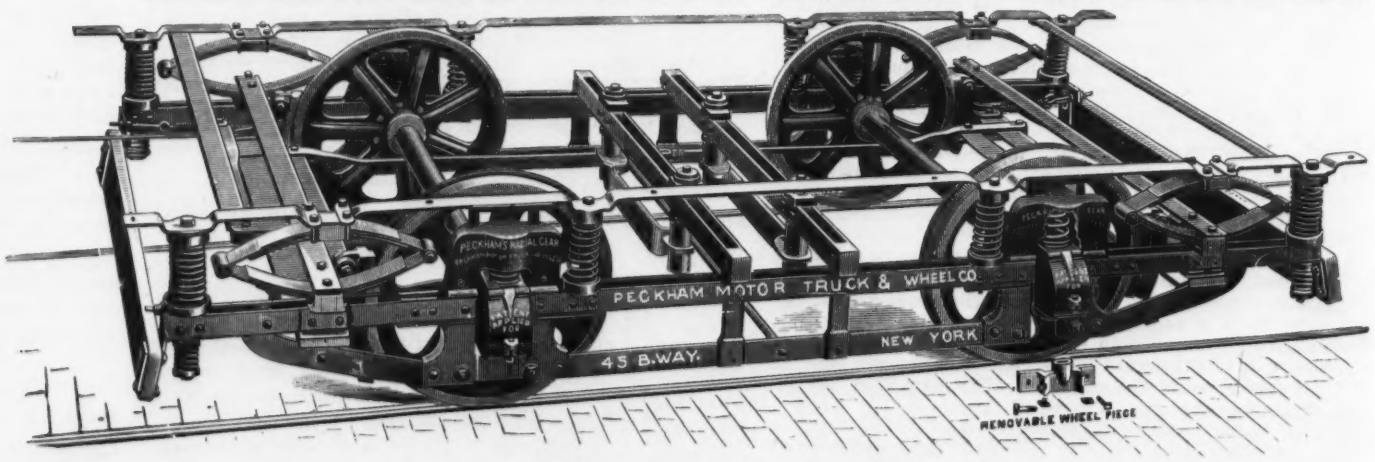
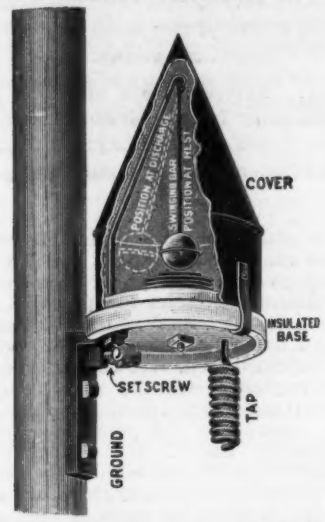


FIG. 2.—THE PECKHAM TRUCK.

The Swinging Ball Lightning Arrester.

In the accompanying cut is seen the improved swinging ball lightning arrester, manufactured by W. A. Vail, 136 street, New York, represented as attached to the pole. Connection to the earth is made at the point marked "ground," while the designation "tap" indicates where connection is made to the line. The only care to be taken is to see that the swinging ball hangs directly over the discharge plate in its normal position. This



THE SWINGING BALL LIGHTNING ARRESTER

lightning arrester has met with marked success, both in the East and in the West, where it is handled by the Electric Appliance Company, of Chicago, Ill.

The American Feed Water Heater.

The saving in fuel to be effected by the use of a feed water heater is now generally recognized, and the consequent demand has resulted in many variations in the principles and forms of apparatus. The American feed water heater, shown in the cut, Fig. 2, manufactured by the Whitlock Coil Pipe Company, at Elmwood, Conn., in 24 different sizes of the standard pattern, and in a number of special forms, is not claimed to be a wide departure from the forms that have heretofore given excellent results in practice, but rather one in which the weak points developed in the older apparatus by use are avoided and the valuable features retained, great attention being paid to mechanical details and workmanship.

The coils are of pure seamless copper tubing and are joined together and also connected to properly designed gun metal fittings by brazing, which makes them virtually jointless. The fitting, which passes through the shell, is tapped for connection with the feed pipes, thereby doing away with all joints inside of the shell. Fig. 1 shows the gun metal fitting used with this type of heater, the ends of the coils being solidly brazed to it, as shown. The fitting is held in place by a gland nut packed with asbestos, which can be easily removed at any time and repacked without disconnecting the feed pipe, which screws into the tapped fitting, the gland nut being on the outside.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, March 25, 1893.

NEW YORK GENERAL FINANCIAL STOCK MARKET.

The week closed with decidedly a better tone and every prospect of a good market during the ensuing week. This condition of affairs was brought about by easier money, a more hopeful feeling in regard to the probabilities of silver legislation, and a resumption of the cotton mill operation in Lancashire. This latter condition was one of the most potent in advancing values. It will enlarge our market, have a tendency to turn the balance of trade in our favor, thus acting as a check against gold shipments. Another very potent factor in bringing about the present condition of affairs is the near approach of the World's Fair. Money was fairly easy throughout the week, at no time going beyond 6 per cent. on call.

NEW YORK ELECTRICAL STOCK MARKET.

The upward movement extended to the active stocks in this list, carrying values fully as high as could be expected under the circumstances. The movement was attended by various items of news having a permanent bearing on the diffirent securities, as will be seen in the following special references. There was a good inquiry for a better class of telegraph stocks, and a feeling that the last fiscal year, returns of which are now coming in, has been a good one, generally speaking.

General Electric.—This stock was the favorite of speculation during the earlier days of the week, and was sold quite freely by the bears on the belief that they detected signs of a disposition among large holders to dispose of their securities. The price from 103¼ on Tuesday weakened to 101⅛ on Wednesday, and on Saturday in the general advance closed very firm at 106¾. A Boston exchange says that during the recent activity in the stock some 14,000 shares of New York holdings were transferred to Boston, thereby exhibiting the faith of the insiders in the property.

Western Union.—Western Union sold 1¼ per cent. ex-dividend on Monday at 93⅜ to ¾. It rallied on subsequent days of the week and closed very strong on Saturday at 93⅞ to 94¼. Talk of a strike had a tendency to weaken the securities during the middle of the week, and on prompt denials of the probability of such a condition the stock readily rallied. We note an advance in the collateral trust 5's to 105, being about 2 points over sales of last week.

Commercial Cable was not traded in during the week. It was bid 148 and held at 170. These figures are ex the quarterly dividend of 1¾ per cent. and ex the right to subscribe at par for the portion of Treasury stock to be issued in payment of the new cable to be laid from Nova Scotia to Ireland.

North American.—There was a resumption of activity in this stock during the week. It was attended by news that the company is endeavoring to sell certain of its securities. It is said by some authorities that these consist of certain bonds of the Milwaukee Street Railway Company. There is another story to the effect that the sale that is contemplated is of the Northern Pacific stock held by the North American Company, and that the transfer means that Mr. Villard is to go out of Northern Pacific management. Be this as it may, the news is considered as excellent by the stockholders, as is indicated by the advance in the stock, which went to 12 against 8⅞ last week.

Electric Light and Insurance.—A contemporary publishes the following: A leading insurance man tells us that for the six months ended Dec. 31 the insurance companies of this city received in premiums about $3,000,000 and paid out in losses about $5,000,000. The losses came principally from electric wires and lights in buildings. For this reason the insurance companies have adopted very stringent specifications in regard to the use of electric lights in buildings, and even under these strict specifications they have raised the insurance rate two cents on each $100, and where they are not followed the insurance is raised 25 cents per $100.

American Bell Telephone.—The rights were opened in Boston at 10 to 10⅛. The dealings are in futures, as shareholders have yet to authorize the proposed $2,500,000 increase in stock, as advised by the directors. The commission on rights is fixed at 10 cents. The right will be to buy one share at 100 for each seven shares now held. At 197⅛ for the stock the street assumes a value of about 187 for the stock ex the privilege. The telephone instrument statement for the month ending March 20 shows: Shipments, 7,265; decrease, 1,069; net output, 3,625; decrease, 1,009.

Commercial Cable.—At the annual meeting of the Commercial Cable Company the following were unanimously re-elected as directors: J. G. Bennett, A. B. Chandler, G. S. Coe, C. R. Hosmer G. G. Howland, R. Irvin, Jr., J. W. Mackay, J. W. Mackay, Jr., E. C. Platt, T. Skinner, Sir D. A. Smith, W. C. Van Horne and G. G. Ward. The report states that the gross earnings for the year 1892 amounted to $1,890,377 and the net revenue to $1,099,587, the latter showing an increase of $14,263, as compared with the year 1891. Quarterly dividends of 1¾ per cent. each have been paid absorbing $540,120, and debenture bonds to the amount of $600,000 were redeemed on Jan. 15 last, thereby reducing the total amount of bonds outstanding to $280,000. In order to provide for laying a third cable, it has been decided to offer to the shareholders, for subscription at par, 19,290 shares of the 22,840 now in the treasury. Each shareholder will be entitled to subscribe for one share for every four shares held.

United Traction and Electric Company.—The first mortgage 40 year 5 per cent. gold bonds of this company issued on the Providence & Pawtucket Street Railway system are offered to investors at par and interest by the Central Trust Company of New York, and Messrs. Clark, Dodge & Co. The proceeds of the present issue, $5,000,000, will be issued to equip with electricity the entire system of roads, aggregating about 82½ miles.

Fort Wayne Dividend.—A dividend of 16 cents per share has been declared on Fort Wayne securities, series A, payable April 1.

Mexican Telephone Company.—The stockholders will meet in this city on April 19 to elect directors.

Brush Electric Company.—At the annual election of this company, held in Cleveland, the following directors were elected: W. H. Lawrence, W. B. Bolton, M. T. Herrick, B. F. Miles, S. M. Hamill, of Cleveland, and C. A. Coffin and J. S. Bartlett, of Boston. The report for the past year submitted was most satisfactory, showing that the alliance with the General Electric Company had proved of benefit to the company. Last year the control of the company was in the hands of Boston, but the Eastern capitalists realized that the charge could well be intrusted to the men who built up the business.

New England Telephone and Telegraph Company has declared a quarterly dividend of 75 cents per share, payable May 15, record to stock of March 31.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, March 25, 1893, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	55¼	55½	55	57
American Bell.....	...	.....	....	.....	...	....
Erie Telephone.....	...	.....	....	...	....	....
New England Teleph'ne..	...	.....	...	....	....	....
Mexican.....	...	.....	..	....	....	....
American Tel. & Cable..	100	14,000,000	90	90	89½	90½
Central & So. Am. Tel....	100	6,500,000	....	...	....	111
Commercial Cables.....	100	7,716,000	†148	170	...	....
Gold Stock & Tel	100	5,000,000	....	....	170	185
Bonds.....	500	500,000	....	....	...	....
Franklin.....	100	1,000,000	....	....	38	42
Mexican Telegraph.....		2,000,000	....	....	....	200
Metropolitan Tel. & Telegraph Co.....		.....	....	....	104	....
Metropolitan Tel.& Telegraph Co. Firsts.....		.....	....	....	102½	....
Northwestern Telegraph.		2,500,000	....	....	104	....
Northwestern Tel. 7's....		.....	....	....	108½	....
Pacific & Atlantic.....		.....	....	....	....	....
Postal Tel. & Cable..... ...		10,000,000	...	....	81½	82½
Southern & Atlantic Tel..	25	948,775	....	....	78	80
Western Union Tel.....	100	94,820,000	*92⅞	94¼	93¾	94
Real estate bonds.. ...1,000		1,219,000	....	....	....	....
Debenture 7's, 1875-1900.1,000		4,920,000	....	....	110	....
Collateral Trust 5's....1,000		8,181,000	103½	105	....	....
North American.....	100	39,767,200	9¼	12	11¼	11½
Detroit Electric..... ...		.....	2⅝	3	....	....
Edison El. Il. of N. Y.....	100	6,100,000	120	126	125	126
" " Ists..... ...		.....	117¾	119	....	....
" " Deb's... ...		.....	....	....	....	....
Edison El. Ill., Boston..... ...		.....	....	....	....	....
Edison El. Lt. Europe....1,000		2,000,000	....	....	2	6
" Bonds.....		30,000	....	....	80	85
Edison Ore Milling Co.... ...		2,000,000	....	....	5	12
East River El. Light.....	100	1,000,000	....	....	....	65
Fort Wayne Electric..... ...		.....	..	....	12¼	12½
General Electric, com .. 1,000		30,395,600	101⅛	106¾	105½	106
" " pref.... ...		.....	....	....	....	....
Debenture 5's		10,000,000	97	98	....	....
Automatic Exhibition Co. ...		2,500,000	.. ..	....	3	5
Interior Conduit & Ins. Co.	100	1,250,000	....	....	62	65
Mt. Morris Electric..... ...		500,000	....	....	....	65
N. E. Phonograph..... .. .		2,000,000	....	....	2	4
N. Y. Phonograph		2,000,000	....	....	2	4
N. American Phonograph ..		2,000,000	....	....	4½	6
U. S. Ilum. Co..... ..		.....	....	....	....	....
Westinghouse common....	50	.....	....	....	....	....
" preferred...	50	.....	....	....	...	....

*Ex dividend.
† Ex rights and dividend.

NEW INCORPORATIONS.

The Globe Storage Battery Company, Chicago, Ill., capital stock $1,000,000, has been formed to manufacture, operate and sell electric storage batteries, apparatus, machinery, etc. J. H. Wheeler, Sigmund Kapy and Louis Dumas are interested therein.

The Citizens' Electric Railway Company of Pottsville, Pottsville, Pa., capital stock $200,000, has been formed to construct and operate an electric railway in Schuylkill county. Z. H. Zerbey, C. R. Acker and R. A. Zerbey are the parties interested.

The West Michigan Electric Company, Grand Rapids, Mich., capital stock $60,000, has been formed to produce, generate and furnish electricity, by water or steam power. E. F. Sweet, A. C. Sekeel and J. E. More, all of Grand Rapids, Mich., are the promoters.

The Electric Power and Storage Company, Ashland, Wis., capital stock $100,000, has been formed to manufacture and sell storage batteries, electric heaters, etc. L. B. Rowley, C. F. Latimer, J. S. Ellis, E. Ellis and C. H. Ziehisdorf are the promoters.

The Anthony Electric Light and Power Company, Anthony, Kan., capital stock $15,000, has been organized to manufacture and furnish electric light, power and heat. George L. Sanders, Walter E. Treadwell and J. H. Carnegie are the incorporators.

The Cambridge & Edinboro Street Railway Company, Edinboro, Pa., capital stock $50,000, has been organized to construct and operate an electric railway in Erie county. Geo. D. Trawin, F. R. Shryock, H. H. Thompson and John J. Shryock are interested.

The Inter-State Traction Company, Philadelphia, Pa., capital stock $60,000, has been organized to construct and operate motors and cables, or other machinery for supplying motor power. The incorporators are H. S. Chandler, C. Eakin Jones and Alexander Simes.

The Middletown Electric Railway Company, of Middletown, Pa., capital stock $100,000, has been formed to construct and operate an electric railway in Dauphin county. W. H. Kendig, E. H. Haffer and Michael Bresth, Middletown, Pa., are the incorporators.

The Springfield, Jacksonville & Winchester Electric Railway Company, Springfield, Ill., capital stock $1,000,000, has been formed. J. E. Self, Geo. Heffaker, Warren Case, all of Jacksonville, and Sam. S. Dewas, Alexander, Ill., and John Gibbs, are interested.

The Brinton Park Street Railway Company, New Castle, Pa., capital stock $20,000, has been formed to construct and operate an electric railway, in New Castle, Pa. Wallace W. Vogan, Alvin M. Stewart and J. C. McMillin, all of New Castle, are the incorporators.

The People's Traction Company, Philadelphia, Pa., capital stock $5,000,000, has been formed to construct and operate motors and cables, etc., for railways. Jno. Lawler Welsh, 1420 Spruce street, Ed. J. Matthews and Caleb F. Fox, Philadelphia, Pa., are the promoters.

The Lake Superior Fuel Gas Company, Chicago, Ill., capital stock $3,000,000, has been formed to manufacture and sell fuel, illuminating gas, and to operate plants for electric light, heat and power. Faye Walker, Robert H. Harris and L. B. Langworthy are the incorporators.

The O'Neill Electric Light and Power Company, of O'Neill, Neb., capital stock $25,000, has been incorporated to own and operate an electric light and power plant in that town. John McHugh, H. M. Uttley, J. A. Hazelet, H. V. Garretson and Levi Harshiser are the promoters.

The Pen Argyl, Bangor & Water Gap Electric Railway Company, Sunbury, Pa., capital stock $300,000, has been formed to construct and operate an electric railway in Northumberland County. The incorporators are A. J. Stroh, J. B. Reed and George B. Renn, all of Sunbury.

The Granite Street Electrical Company, of Concord, N. H., capital stock $30,000, has been formed to manufacture and sell electrical machinery, etc. S. L. Bartlett, H. O. Marsh, H. W. Ranlet, Sam F. Prescott, A. C. L. Cushman and W. P. McLane, of Concord, N. H., are the promoters.

The New York Electrical Works, New York City, capital stock $50,000, has been formed to manufacture and sell electrical instruments and appliances. F. K. Fitch, 161 Washington street, New York City, M. A. Smith and Howell Smith, 224 Keep street, Brooklyn, N. Y., are the organizers.

The Jersey Shore Electric Light, Heat and Power Company, Jersey Shore, Pa., capital stock $5,000, has been formed to supply light, heat and power. George Ramsdell, R. H. Lawshe, Robert McCullough and Hamilton B. Humes, all of Jersey Shore, are interested in this project.

The Electric Railway Equipment Company, of Jersey City, N. J., capital stock $120,000, has been formed to manufacture and deal in electrical appliances and devices. George C. Hackstall, F. C. Esmond, Paul K. Ames, Brooklyn, N. Y., and Percy Jackson, Belleville, N. J., are parties interested.

The Wellston Belt and Street Railway Company, Wellston, O., capital stock $10,000, has been formed to construct and operate a street railway in that town to be operated by electric or other power. The promotors are H. Wells, F. A. Hockett, E. B. Bingham, J. C. Clutts and J. J. Bennett.

The Royersford & Spring City Street Railway, Royersford, Pa., capital stock $12,000, has been formed to construct and operate an electric railway in Montgomery county, Pa. Wm. Albright, Spring City; E. L. Hallman, Royersford, and G. M. Lewis, Wilkes-Barre, Pa., are interested.

Ocean City Electric Light Company, Ocean City, N. J. capital stock $30,000, has been formed to supply electricity for light, heat and power. Those interested are E. B. Lake, Sam Sampson, A. D Scull, R. H. Thorn, C. A. Campbell, Wm. Lake, all of Ocean City, and Gilbert E. Palen, of Philadelphia, Pa.

The Elliott Electric Company, of Cleveland, O., capital stock $15,000, has been formed to manufacture and repair, and also to deal in all kinds of electrical machinery and appliances. J. E. Elliott, S. Kinkaid Elliott, Wm. H. Elliott, Evan H. Hopkins and Francis C. McMillin are the incorporators.

The Somerset Lighting Company, Somerville, N. J., capital stock $100,000, has been formed to manufacture and generate gas and electricity and to transmit same by pipes and wires, etc. F. Everhart, New York City; D. K. Craig, F. H. Cole and Jas. L. Griggs, Somerville, are the promoters.

The Citizens Electric Power and Street Railway Company, of San Antonio, Tex., capital stock $600,000, has been incorporated to construct and operate an electric street railway, and to erect an electric light and power station, to supply light, power and heat. A. H. Dollard, Brooklyn; Wm. J. Clark, F. A. Barnaby, Fred G. Dow, all of New York City, N. Y.; and H. E. Barnard and C. C. Creseon, of San Antonio, Tex., are the promoters.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, March 27, 1893.

Mr. A. H. Patterson, manager Phœnix Glass Company, left last week for Chicago, where he will superintend the placing of his company's exhibit at the World's Fair.

Mr. J. T. Palmer, who for the past two years has been operating electrician at Columbia College, has accepted an offer to be chief electrician for Mr. Harry Miner's theatres, with headquarter at the Fifth Avenue Theatre, New Year City.

The Wrought Iron Bridge Company, of Canton, O., and 136 Liberty street, New York, is now preparing to manufacture a patent pole for electric railways, which will combine many of the best features desired. This company is now prepared to manufacture a very superior pole, but hopes in the near future to have the best pole on the market. Special machinery will be installed to turn out 200 poles a day.

Mr. Samuel D. Van Raust, superintendent of the wiring department of the U. S. Illuminating Company, has been prevailed upon by Mr. August Daly to go to London for three months to superintend the electrical equipment of his new theatre in Leicester Square. Mr. Van Raust is well fitted for this sort of work, having made a study of the electric lighting of theatres for some years and installed plants in several of the most important theatres in this city, including the Casino.

Quick Work of the Cable.—An illustration of the rapidity with which news may be transmitted over long distances is the feat accomplished by the Direct United States Cable Company in signaling the result of the Oxford-Cambridge boat race to the United Press within 13 seconds of the finish. The race was ended at 4 o'clock 51 minutes 47 seconds P. M., Greenwich time, and the result was announced to the United Press in New York over the Direct Cable at 4:52 P. M., Greenwich time—less than a quarter of a minute being consumed in obtaining the news at the course, forwarding it through London and across the Atlantic, and signaling it to the New York office of the United Press.

The Board of Electrical Control, at a recent meeting, adopted a resolution directing all district and burglar alarm companies above 125th street to notify the board within ten days that they intend to take down the overhead wires and place them in the subway. The Postal Telegraph Company sent a letter to the board requesting subway privileges on Washington street between Fulton and Chambers. Permits were granted to the North River Electric Light Company for pole lines in Boston avenue and on 172d street. The Third Avenue Railroad Company applied, through its counsel, Edward Lauterbach, for a one wire subway along its cable line. It is proposed to establish stations at intervals, so that communication can be maintained by telegraph all along the line, in order to prevent accidents. The application caused a long discussion and no action was taken. Mr. Lauterbach submitted a brief. Subways were ordered to be built for the New York Heat and Light Power Company on Worth street, from Broadway to Park row; on Fulton street, from Pearl to South; and for the Edison Electric Light Company on Fifty-ninth street, from Madison to Fifth avenue, and on 125th street from Lexington avenue to the East River.

Banquet to Director-of-Works Burnham.—On Saturday evening Mr. D. H. Burnham, director of works at the World's Fair, was honored by a banquet in the Madison Square Concert Hall, given to him by the architects, painters and sculptors of this city as a testimonial of the manner in which he had discharged the duties of his official position. In an alcove stood a fac-simile of the gigantic statue of the Republic at the Exposition. Mr. Richard M Hunt presided, and the most prominent representatives of the profession were present. Letters of regret were received from President Cleveland, Governor Flower, Governor Russell, of Massachusetts; Theodore Thomas and others. During the evening the room suddenly became dark and pictures of all the buildings of the Exposition were shown, as well as some of the more important paintings and pieces of statuary. Mr. Hunt at the close of the opening speech presented to Mr. Burnham a loving cup bearing in bas-relief the statues of Sculpture, Architecture and Painting. The toasts and responses were as follows: "The Arts," Charles Eliot Nilson; "The White City," Richard Watson Gilder; "Columbus," Charles Dudley Warner; "Our Country," William Lindsay; "The

Exposition," Lyman J. Gage; "New York," Horace Porter; "The Rest of the World," Joseph H. Choate; "Chicago," J. S. Norton.

ALBANY, March 25, 1893.

The Consolidated Car Heating Company has decided to reduce the capital stock to $1,250,000. It has also been decided to increase the plant by the purchase of new machinery.

The Cayadutta Electric Railway Company is considering the advisability of having built a number of double-decked electric cars to be used during the summer on excursion trips.

The Hudson River Telephone Company has made a change in the night service by putting young women in place of young men at the switchboard. Acting General Manager Henry E. Hawley, whose effort it is to make the service of the telephone system in Albany a model one, believes that young women are more attentive and obliging in their work than young men. A marked improvement in the night service is the result of the change.

The Nassau Electric Railway Company has filed a certificate of incorporation with the Secretary of State. The company is capitalized for $6,000,000, and will operate a double track street surface railroad for a distance of 27 miles in and around Brooklyn. The directors are: P. H. Flynn, George Damen, George S. Studwell, Fred C. Cocheu, J. B. McQuillan, William J. Studwell, Silas B. Dutcher, Brooklyn; James F. Casey, Albany, and F. H. Johnson, New Utrecht.

Many bills have been before the legislature recently affecting electrical interests Among those introduced were the following: Legalizing the agreement between the Binghamton Street Railway Company and the Binghamton & Port Dickinson Railway Company on April 26, 1892; prohibiting the construction of a railroad in Greene avenue, Brooklyn, between Franklin avenue and Broadway, without the consent of a majority of the adjacent property owners and of the mayor and common council of Brooklyn; providing for the election in Long Island City of a commissioner of street improvements to hold office four years and defining his duties; prohibiting the construction of a railroad on Hamburg avenue in Brooklyn, between Flushing and Myrtle avenues, except with consent of property owners upon that portion of the avenue; prohibiting the erection of a telephone pole without the consent of the owner of the property on which it fronts; prohibiting the charge for telephone service for any period it is out of order for over 24 hours; and providing that outside of New York and Brooklyn the telephone charges shall not be hereinafter increased from those in force on March 1 last.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 31, CITY TRUST BUILDING, 927 Chestnut St.,
PHILADELPHIA, Pa., March 25, 1893.

Mr. John Gill, Jr., of Philadelphia, has gone to Chicago on a business trip.

Mr. Register, of the firm of Pepper & Register, Philadelphia, is confined to his house by illness.

Mr. I. Kelly, of the Acme Gas Fixture Company, has been ill for the past few days, confined to his home.

Mr. E. Blanton, of the Howard Foundry and Machine Company, of Philadelphia, has gone south on a business trip.

Mr. C. E. Trump, of the Novelty Electric Company, of Philadelphia, reports having taken many orders for his new fan motor during his recent Southern trip, although the object of his trip was principally pleasure.

The Board of Education of Philadelphia has awarded the contract of supplying the electric and gas fixtures, and fitting up the same, in all the public schools of Philadelphia during 1893, to the Acme Gas Fixture Company. This company also made a recent contract to put in the fixtures in a large Catholic church in Albany, N. Y. Mr. I. Kelly, the business manager of the Acme Gas Fixture Company, reports business exceedingly good, so much so that he has decided to move on the ground floor of his present address, 1236 Filbert street, where he will have more commodious quarters.

PITTSBURGH NOTES.

PITTSBURGH, Pa., March 25, 1893.

A meeting of a number of stockholders of the Essick Telegraph Printing Company was held in this city last Tuesday. The company was organized six years ago in the East, with a capital stock of $5,000,000. Of this sum 10,000 shares at $100 per share, or $1,000,000, were taken in Pittsburgh. This amount of stock was represented at the local meeting. The company has not been successful, and matters were brought to a crisis by some of the disgusted Pittsburghers offering their stock in Boston at $10 per share. At this price they could not sell. When some of the stockholders heard of it, they called a meeting, and after discussing the subject they decided to pool their stock and keep it off the market for a year. This was done to give the parent company a chance to make 1,000 new machines and redeem the business. The success of Elisha Gray, the Chicago man, who is also pushing a printing telegraph, disconcerted the local stockholders. They were afraid that Gray and his people will get ahead of them. Since the organization of the company the Pittsburgh stockholders have not received a dividend and are discouraged. A company has a line in operation between Boston and Danielsonville, Conn., and pays a royalty of 25 per cent. to the parent company.

The Westinghouse Electric and Manufacturing Company has just completed the installation of an electric power plant in Pomona, Cal., which is in many respects the most unique plant of its kind in the world. Mr. Winslow, one of the Westinghouse electrical engineers, arrived in California in July, and on the 16th of November last made the first test of the plant, which test proved very satisfactory in every respect. The plant is erected for the purpose of transmitting by electricity the power from a waterfall over long distances. The generating plant is located in the San Antonio canyon, 14 miles from Pomona and 28 miles from the city of San Bernardino. Pelton wheels operating under a head of more than 400 feet and at a pressure of about 200 pounds per square inch are used to drive the generators, the shafts of which are connected by couplings with the shafts of the wheels. The wheels, and of course the generators, operate at 600 revolutions per minute, and each generator delivers alternating current at a pressure of about 1,000 volts to a bank of transformers, by means of which the pressure is increased to 10,000 volts. At this pressure which is the highest used in any installation in the world operating on a commercial basis, and, with the exception of the experimental plant used in Frankfort in 1890, the highest that has ever been attempted, the current is transmitted over one circuit to the town of Pomona, and over another circuit to the city of San Bernardino. At these points, in all sub-stations, banks of reducing transformers are located, by means of which the pressure is reduced to a voltage that may be safely distributed throughout the towns. Bare copper wire is used for the transmission circuits, and special insulators, designed by the Westinghouse company and manufactured in Pittsburgh and in Washington, Pa., are used. The installation has been successful from the start, and with the exception of a delay of less than one day, caused by the bursting of one of the water pipes under the very high pressure, there has been no interruption of service. The electrical apparatus has given no trouble, and the plant is now supplying about 500 incandescent lamps in the town of Pomona, and a somewhat greater number in San Bernardino, while additional lamps are being connected as rapidly as they can be wired. The importance of this practical demonstration of the ability of electrical machinery to transmit energy over such distances as these can scarcely be overestimated. This plant in Southern California is perhaps the first to commercially demonstrate that this energy can be utilized 28 miles, or even at a greater distance, from the water power.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., March 25, 1893.

Mr. O. W. Hart, lately of Fall River, has been appointed New England agent of the Ford-Washburn Storelectro Company, of Cleveland, O. Mr. Hart has taken offices in the Hathaway Building, 620 Atlantic avenue, Boston, Mass., where he will be pleased to meet his friends.

F. G. Stimpson and James P. Merridew are at the head of a company organized to build an electric light plant at Rockport, Mass. The company has been granted a franchise and a five-year contract to light the streets of Rockport, and work on the erection of the plant will be begun shortly.

The Danbury & Bethel Horse Railway Company, of Danbury, Conn., of which S. B. Holly is president, and J. B. McGeorge secretary and treasurer, has finally been granted a franchise by the Council to substitute electricity for animal power on its street railway system at Danbury. Work will be started soon.

A big deal involving the exchange of $500,000 in money and the transfer of the controlling interest in the Ottawa Gas Company and Ottawa Electric Light Company, of Ottawa, Canada, has just been made public. It is said the next move of the syndicate will be securing the controlling interests in the different gas and electric companies of Montreal and Toronto.

A permit has been obtained by the Newton & Boston Street Railway Company for an electric plant of sufficient size to supply power not only for the Upper Falls line, but also for several of the other electric roads projected in Newton, and the company will at once proceed with the erection of a large power-house. The building will be a large wooden structure, and will be fitted up with a 375-h. p. steam engine and complete electrical apparatus. The roads operating in Newton have heretofore been supplied by power furnished by the Waltham Electric Light and Power Company.

Dr. Wellington Adams, general manager of the Chicago & St. Louis Electric Railway, was one of the guests of the Parker House, Boston, during the recent burning of Tremont Temple. The doctor took things very coolly and stated to a local news reporter that he believed that the good work of the hotel employés alone prevented a far greater conflagration taking place. He incidentally remarked that his company has met with most excellent success in the sale of its stock, and that work under the recent contracts, which call for complete track equipment, was about to begin on a large scale.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, March 25, 1893.

The Electric Appliance Company has just issued catalogue No. 5, descriptive of its electric and combination fixtures and fixture accessories. The catalogue shows a very complete line of fixtures.

The Chicago Electric Club will hold its next literary meeting at the clubrooms, 175 South Clark Street, Chicago, at 8 P. M. on March 20. Mr. J. K. Pumpelly will present a paper entitled "The Present Status of the Storage Battery," which will be illustrated by the exhibition of samples of the old and improved forms of storage batteries.

The Chicago City Railway Company is pushing its construction of crosstown lines vigorously. These will all be operated electrically, and will be completed in time for World's Fair traffic. There will be over 120 miles of crosstown electric roads. The Ansonia Electric Company (formerly the Electrical Supply Company), of Chicago, has secured the contract for the overhead equipment of these lines.

Mr. Robb Mackie, who for nearly a year past has occupied the important position of city electrician for the city of Cincinnati, has resigned from the post to accept another in New York. Mr. Mackie's abilities as an electrician are too well known to require rehearsal here, and were so fully appreciated in Cincinnati that the Board of Administration paid him the unusual compliment of offering him $1,000 increase in salary as an inducement to remain. Cincinnati's loss will be New York's gain.

Pneumatic Tube Service.—Chicago capitalists are contemplating the establishment of a company with the object of introducing into the postoffice, into the Fair Grounds, and eventually into all the large buildings a system of pneumatic transmission of mails. The company will be known as the Illinois Electric Pneumatic Transit Company. The capital is to be $1,000,000, and the board of directors is to include some of the leading business men of the city. The Clay Electro Tube method of transmission is to be used.

CLEVELAND, O., March 25, 1893.

Youngstown is to have a belt line electric road. It will be built by the Youngstown Electric Street Railway Company.

An electric line is proposed connecting Canfield and Cornersburg with Youngstown in this State, the length to be about nine miles.

Salem, O., has let a ten year contract for lighting the city with arc lights of the Fort Wayne system to Cooper and J. B. K. Turner, of Canton.

The right of way has been secured for the electric road between Fostoria and Findlay. G. B. Kasper, of Cincinnati, is at the head of the company.

At the coming election at Ashtabula the question of bonding the town to the amount of $15,000 for municipal electric light will be submitted to the voters.

Postmaster Anderson, of this city, has a scheme on foot for distributing the city mail by means of the electric roads, thus doing away with the mail wagons.

The Johnson Grover syndicate has obtained a franchise to construct a road to Cincinnati, after a long fight with the consolidated interests in that place.

The four-cent tickets have appeared on the East Cleveland road. Passengers can now procure slips of six tickets for 25 cents, and books containing 25 tickets for $1.

Col. J. T. Brown, of Toledo, it is reported, is pushing a project for an electric road to connect Findlay and Toledo, running through Perrysburg, Bowling Green and North Baltimore.

Contracts for the Miamee Valley Electric Railway were let on March 14. The Johnson Company, of Johnstown, Pa., was awarded the contract for the rails, and the St. Louis Car Company the contract for the rolling stock.

The street railway employes in this city are planning to organize again and connect themselves with the Knights of Labor. The former organization has pretty well died out since the strike on the East Cleveland road last summer.

Citizens of Willoughby, a town some 15 miles east of Cleveland, along the line of the Lake Shore road, have requested the East Cleveland road to extend its suburban line, which now reaches to Euclid Creek, some 5¼ miles beyond the city limits, to Willoughby.

L. A. Russell has resigned his position as counsel in the Brooklyn and South Side roads. It is understood that this step is the result of the competition for the cross-town line, where Russell is interested in the Short-Potter syndicate, which is bidding for the route in opposition to the Brooklyn road.

The Broadway & Newburgh and East Cleveland directors met and ratified the project of consolidation on the 11th inst. The stockholders will meet and give their consent on March 25. When the combination takes effect a four-cent fare will be introduced on the Broadway & Newburgh line

All the street railroads in town, excepting the Broadway & Newburgh line, have posted notices in their cars that owing to the reduction in price East Cleveland tickets will not be received on their cars for fare. The East Cleveland Company, however, continues to receive the tickets of all other roads.

H. C. Bunts was before the Board of Control of this city last Friday in the interest of the proposed storage battery crosstown route on Wilson avenue. The Board of Control has taken the matter up and will investigate the efficiency of the system proposed, which is that of the Ford & Washburn Storelectro Company.

The East Cleveland Railway Company started on the 13th inst. to double track its line between Lake View and Collinwood branch. The hamlet of East Cleveland, however, immediately got out an injunction on the work. The East Cleveland Company claims to have a charter dating back prior to the formation of the hamlet, which permits it to lay double track where it desires.

A legislative blockade has been instituted by Director of Law Meyer against the crosstown ordinance, which is being pushed by the Johnson interests, on account of the failure of the Brooklyn road to provide their motor cars with headlights. Director Meyer declares that the ordinance shall not move until the Brooklyn road complies with the wishes of the city in this matter.

Two new routes for the crosstown road in the East End are now being considered, one across East Madison avenue, about one mile east of the route proposed by the Short Russell syndicate, and the other across Doane street, about two miles east of the route just mentioned. The opinion that the East Cleveland road will put forth strong efforts to obtain the crosstown franchise is steadily gaining ground.

Articles of incorporation for an electric light and street railway company at Mt. Vernon were before the legislature last week. This company proposes to absorb the Mt. Vernon Electric Light Company, and will soon begin work on a street railway leading from Mt. Vernon to Gambier, about eight and one-half miles long. The charter will include a railway through Fredericktown and on to Marion.

The equipment of the Woodland Avenue & West Side road power station is now nearly complete. All six generators and three engines are in position and four machines are at work. A fight is on foot between the residents on Bridge street and the Woodland Avenue & West Side road, owing to the long intervals at which cars are run. An ordinance was introduced at a meeting of the Council last Monday night to revoke the company's franchise for the use of this street in case it failed, within ten days, to run cars under a ten-minute headway.

News of the Week.

THE TELEPHONE.

A telephone company has been organized at Osceola, Ark.

Guthrie, Oklahoma, has granted a franchise for a telephone system.

Caldwell, Kan., has granted the Missouri & Kansas Telephone Company the right to operate telephone lines in that city.

The Minnesota & Wisconsin Telephone Company has been formed with a capital of $100,000 to operate in Superior and Duluth, Wis.

Marquette, Mich., has completed arrangements for the installation of a new telephone exchange to compete with the Michigan Bell Telephone Company. The Harrison automatic switch system is to be used.

Joliet, Ill., has granted a franchise to J. L. Grose for the construction and operation of a telephone system. The ordinance provides that the branch shall be in operation within a year from the date of the franchise which shall be in force for 20 years after that date; that telephones for all city officials shall be furnished free and that the rentals for telephones shall not be more than $30 per year for residences and $40 for business houses.

THE ELECTRIC LIGHT.

An electric light plant is now being projected at Delta, Cal.

Red Cloud, Kan., is making an effort to secure electric lights.

The Portland (Ore.) General Electric Company's contract for lighting the city has been signed by the mayor and auditor.

Wabash, Ind.—A half interest in the Wabash Electric Light Company has been sold by George Webster, the Marion banker, to Thomas McNamee, of Wabash. The company is extensively engaged in public and private lighting.

Columbus, O.—A report has been recommended to and adopted by the city council to instruct the committee on state relations and the city solicitor to prepare a bill to be presented to the legislature to issue bonds to the amount of $250,000 for the establishment of an electric light plant for the city of Columbus.

The Neptune Electric Light Company, of Asbury Park, N. J., has closed the contract for constructing its lines between Belmar Spring, Lake Como and its plant at Asbury Park. The

consent of the property owners, franchises, rights of way, etc., have been secured, and the wires will be in position ready to furnish light within the next three weeks.

The Catskill Illuminating and Power Company, which really is the Thomson-Houston Electric Light Company, has absorbed the Catskill Gas Company, a concern that has done business with more or less profit ever since 1858. The gas company sells its plant and franchise, the exclusive right to manufacture and sell illuminating gas in Catskill, for the sum of $40,000.

Electric Light Companies Consolidate.—A certificate of consolidation of the Greenwich Electric Light and Power Company and the Cambridge, N. Y., Electric Light and Power Company, forming the Consolidated Electric Company of Greenwich, has been filed with the Secretary of State. The capital of the new company is $35,000, and the directors are: Henry Gray, Le Roy Thompson, James Lavake, John Brooks, Mortimer R. Teffts, Harry C. Gray, Greenwich, and Jerome B. Rice, Andrew B. McNish and John L. Agan, of Cambridge. The company's operations will be carried on in the towns of White Creek, Cambridge, Jackson, Easton and Greenwich, Washington County, and the town of Schuylerville, Saratoga County.

THE ELECTRIC RAILWAY.

The Buffalo (N. Y.), Belleville & Lancaster Electric Railway will be the first of the trolley roads in the suburbs of Buffalo to be put in operation, and it is stated that the cars will be started on April 1.

The Mt. Vernon (O.) City Council, as an inducement to the Mt. Vernon Railway and Light Company, which owns the franchises for a street railway at that place, to build the lines at once, has awarded to the company a 10-year extension of its contract for lighting the city.

The Lake Roland Elevated Railway Company, in compliance with an order from the city solicitor of Baltimore, is busy removing its recently laid double tracks on Lexington street and will replace them with a single one in the centre of the street.

The electric street railway line formerly operated by Russell Harrison and others, at Richmond, Ind., has been sold to B. N. Hobart, of the Kansas & Texas Coal Company; H. R. Fordice, of the Iron Mountain Railroad, and S. Kerens, of St. Louis; J. F. Miller, of the Pennsylvania Railroad; R. A. Jackson and H. C. Starr.

The Indiana Electric Power Company has been granted a franchise by the Goshen City Council to build and maintain a street railway system within the city limits. The company is to have cars running within a year, and in addition proposes to connect the towns of Napanee and Elkhart with the county seat by independent lines.

The New York State Railroad Commission has granted the application of the Atlantic Avenue Railroad Company, of Brooklyn, for a change of motive power to the overhead electric trolley system upon certain portions of its route not heretofore granted; also the application of the Mount Vernon & East Chester Railway Company for a similar change of motive power.

A New Traction Company.—The certificate of organization of the Hudson & Bergen Traction Company was filed at Trenton, N.J., yesterday. The incorporators are Miles Tierney, of New York; Theophilus Butts, of Hoboken, and Albert C. Wall, of East Orange. The capital stock is $5,000,000. No route was filed with the certificate, but it is said that the new company propose to build electric roads through Hudson and Bergen counties, in New Jersey.

The Baltimore Traction Company has bought the Baltimore & Curtis Bay Electric Railway. The price paid is not generally known, but is supposed to be an advance on the former owners' capital stock of $200,000. The road is four and a half miles long, operates 22 cars and enjoys heavy and regular travel, and as it already connects with the Traction company's Fort avenue line it will prove a valuable addition to that company's system.

The Ashtabula, O., City Council has passed an ordinance granting a franchise for another street railway line between the city and harbor, to be run on the east side of the river. The road is to be completed June 1, 1894, and the franchise provides that for a period of five years from that date horses may be used, and thereafter electricity must be substituted. The rate of fare will be the same as on the present electric line, viz., five cents or twenty-five tickets for $1.

New Electric Road.—The following prominent business men of Norwalk, O., have forwarded articles of incorporation to Columbus for building the Norwalk & North Fairfield Electric Railroad: Hon. John A. Williamson, Harry H. Hoyt, Hon. C. P. Wickham, Rev. Dr. T. F. Hildreth, J. F. Laning, Hon. S. E. Crawford and Frank D. Evans. The road will eventually connect with the Big Four road to Mansfield and other points. The line will be built and controlled by Norwalk men, and will be of incalculable benefit to Norwalk.

Needham & Newton Electric.—The Needham (Mass.) Selectmen have granted a franchise to the Needham & Newton Electric Street Railroad Company to lay tracks from Chestnut street to Highland avenue, and from Highland avenue to the Newton line. The company has also a franchise to build from the Needham line on Needham street to Winchester street, to Centre street, to Walnut street, to the track of the Boston & Albany Railroad. The road will be about 4½ miles in length, and it is expected to be in operation by the 30th of May.

The New Jersey Traction Company has applied for a franchise to operate an electric trolley road on Bloomfield avenue to the Montclair line, as part of the system to run from Caldwell to Bridge street, Newark, and from there to Jersey City. Several property owners along the proposed line of railroad protested against granting the franchise unless the company agreed to build the road in the centre of the street. As Bloomfield avenue is a county road, under the supervision of the Board of Freeholders, the matter was referred to the Town Council to ascertain if the committee had the power to grant the franchise.

The Metropolitan Traction Company has asked the New York Board of Aldermen for three more extensions, as follows: An extension or branch of the Lexington Avenue & Pavonia Ferry Railway Company's lines from Lexington avenue through Ninety-sixth street, First avenue, Ninety-third street and Avenue A to the Astoria Ferry; a connecting link between the Columbus or Ninth avenue line and the Sixth avenue line, through West 110th street or Cathedral parkway, from Columbus avenue to Eighth avenue, and an extension of the Columbus or Ninth avenue line from Amsterdam avenue through West 125th street, the Boulevard, West 130th street, Twelfth avenue and Manhattan street to the Fort Lee Ferry.

The West Traction Company, of Philadelphia, has been granted a charter. The object of the formation of this company, as stated by the incorporators, is to absorb the Forty-second street, West Park, the Forty-ninth and Westminster streets and the Philadelphia West Side Passenger Railway companies. This action, it was said, was made necessary by a city ordinance which provided that a passenger railway company was allowed only one complete circuit of a route. The parties interested desired three distinct routes, and the formation of the three companies resulted. Several weeks ago these companies applied to Councils for permission to equip their lines with the trolley system, and their applications were referred to the sub-committee of the railroad committee.

Five More Trolleys.—The additional trolley ordinances of the Philadelphia Traction Company have been ordered to be favorably reported to Councils at a meeting of the Railroad Committee. The ordinances propose to substitute trolley for horse-power on these routes: The Thirteenth and Fifteenth Streets Passenger Railway Company, and an extension north to Cambria street; Union Passenger and the Kessler Street Connecting Passenger Railway companies, on the Wallace and Spring Garden streets route to Fairmount Park; the Philadelphia City and Walnut Street Connecting Passenger Railway companies, on Chestnut and Walnut streets to Sixty-third; the Seventeenth and Nineteenth Streets Passenger Railway Company; the Continental Passenger Railway Company, on Filbert and Sansom and south on Eighteenth and Twentieth to Morris streets.

Electricity for an Interurban Road.—The project of building an air line between Chicago and Milwaukee has been revived and it is said that work on the proposed line is to begin at once. Chicago and Eastern capitalists, who are behind the project, are said to have organized a company with a capital stock of $10,000,000. Henry C. Payne and C. C. Rogers are the Milwaukee representatives of the company, and through them a right of way is being secured from Milwaukee to the Illinois State line. Chicago men are looking after the right of way in Illinois and into Chicago. The line is to touch at Evanston, Waukegan, Kenosha, Racine, South Milwaukee and Cudahy. The intention of the company is to establish rapid transit between Chicago and Milwaukee. Trains of two or three cars will be run at intervals of every half hour and they will, it is claimed by those interested, make the through run in 1 hour and 20 minutes.

PERSONAL NOTES.

Mr. Herbert Laws Webb, of the Electric Selector and Signal Company, 45 Broadway, sailed Wednesday, March 22, on the Majestic. Mr. Webb is visiting England in the interests of his company.

Mr. W. A. Fenn, General Manager of the American Electric Supply Company, of Buffalo, N. Y., has been called to Memphis, Tenn., where his brother, J. E. Fenn, electrician of the Southern Division of the Western Union Telegraph Company, is lying ill with typhoid fever.

Col. F. A. Mason, of Bridgeport, Conn., died at Cornwall on March 25, from a disease of the brain. When taken ill, three years ago, he was treasurer of the Bridgeport Brass Company. He was born in Torrington, 51 years ago, and commanded the Thirteenth Regiment of Brooklyn at the time of the Orange Riots. He was formerly president of the People's Steamboat Company and a director of the Pequonnock National Bank. He leaves a wife, one son and two daughters.

Mr. Walter P. Phillips has been elected secretary of the Lotos Club, of which he has been a member since 1877, and a director for the past three years, as well as a member of the Committee on Literature. Mr. Phillips is General Manager of the United Press and occupies one of the most important positions in the newspaper world. He is a native of Massachusetts, but when a boy moved to Providence, R. I., where he learned telegraphy and became one of the fastest operators in the country. He then turned his attention to newspaper work, and about twenty years ago came to New York City, where he held various important places before assuming his present position.

MISCELLANEOUS NOTES.

An ordinance will be introduced in the Baltimore City Council at its next meeting providing for a tax of $2 on each electric light, telephone and telegraph pole, and on each trolley pole which carries wires other than those in use by the railway.

The International Exhibitors' Association, at a recent meeting of the Executive Committee, decided to close the Eastern office of the Association on April 1, and from that time its principal office will be on the Exposition Grounds, Chicago. A resolution was also passed expressing satisfaction with the manner in which the recent applications for space by New York exhibitors have been treated by the officials of the Fair in the final readjustment of space.

The Commercial Cable Company is preparing an exhibit for the Chicago Exposition which will undoubtedly prove to be one of the most interesting in the Electricity Building. It will present, in miniature form, a complete model of the Mackay-Bennett system. The exhibit will be installed in a pavilion expressly designed for the purpose, the sides of which will be made to represent as nearly as possible the two terminal stations of the company at Dover Bay, N. C., and Waterville, Ireland. The apparatus used will be duplicates of the instruments employed in these stations.

Electricity on the Canal.—The arrangements for making experiments with electricity on the Erie Canal are said to be going forward satisfactorily. Sherman Petori, to whom a permit was given some time ago, stated a few days ago that he was going to test the matter thoroughly. He had a company with $50,000 capital all ready to undertake the work. The locality selected is the line of canal from Albany to Troy. Before the season is far gone it will be known whether the trolley system can be profitably introduced on the canal. It is to be hoped that it will succeed, not only for the advantage of the canal, but for the final emancipation of the canal horse.

The National Brotherhood of Electrical Workers of America, through a communication from its president, states that the grievance with the New York Insulated Wire Company covering a contract on the construction work for the World's Columbian Exposition has been amicably settled, and in consequence of the disposition shown toward them by the New York Insulated Wire Company, in enabling them to adjust the differences with the directors of the Columbian Exposition, they are induced to request that all objections to the goods manufactured by the New York Insulated Wire Company shall be removed at once, and that, on the contrary, they shall be recommended.

Industrial and Trade Notes.

The Conover Manufacturing Company, of 95 Liberty street, report continued large orders for condensers. Duplicate orders speak volumes.

Mr. A. A. Temple has retired from the firm of Temple & Bussey, which has hitherto conducted the business of the Electrical Repair Works, 327 Washington street, Buffalo, N. Y.

Messrs. J. C. Mortimer & Co., of 136 Liberty street, who make a specialty of buying, selling and repairing electrical apparatus, report an encouraging outlook for the coming season.

Robert D. Bussey, Jr., is the successor to the Electrical Repair Works, 327 Washington street, Buffalo, N. Y. There will be a considerable change in the line of business and its conduct.

Mr. B. E. Davis, traveling salesman for Pass & Seymour, of Syracuse, was in New York last week. Mr. Davis reports a large and increasing demand for the specialties manufactured by his company.

The Brown Telegraph and Telephone Company, of Chicago, which owns the patents and inventions of F. H. Brown, has issued a pamphlet setting forth the merits of this system and the claims of the validity of the patents.

The Burgess Soldering Furnace Company, of Columbus, O., which manufactures gas and gasoline furnaces for the use of tinners, plumbers and electricians, is doing an extensive business in this line, shipping its furnaces to all parts of the world.

Mr. R. J. Brittain, of the Safety Electrical Company, Newark, N. J., has placed upon the market a line of motors and dynamos up to 10 h. p. The special features of this companies products are economy, simplicity and adaptability to lighting, power and the electro-deposition of metal.

The C. & C. Electric Motor Company, of 402-404 Greenwich street, New York, has just issued an elegantly illustrated pamphlet setting forth the adaptability of its motors and dynamos for use in mills and factories. It is the handiwork of Mr. A. Mitchell Hall, the general Manager of the company.

The Ball Engine Company, Erie, Pa., is to furnish four 150-h. p. engines for the electric plant of "The Mackaye Spectatorium" of the Columbian Celebration Company, which is to be one of the most unique and interesting features of the Columbian Exposition, and which will be to the Columbian Exposition what the Eiffel Tower was to the Paris Exposition in 1889.

The General Electric Launch Company, 44 Broad street, New York City, has issued a very artistic little catalogue setting forth the many advantages of electric launches, and calling attention in particular to the launches which it manufactures. It is prepared to contract for building and equipping launches propelled by electricity of any style and finish, and of any size from 20 ft. to 100 ft. in length.

Frank N. Slade, Columbus, O., manufacturer of coal mining apparatus, who recently succeeded the Letchner Manufacturing Company, has lately sold a complete electrical plant and Slade mining apparatus to the Greendale Furnace Company, Murray City, O.; and to the Athens Coal Company; to the Last Run (O.) Coal Company, and to the Somers Coal Company, near Murray City, O., a Sherry electric light plant.

The Bryant Electric Company, of Bridgeport, Ill., should have been accredited with the handsome exhibit of switches made at the St. Louis Convention, with which Mr. Thos. G. Grier's name was connected in the last issue of THE ELECTRICAL WORLD. Mr. Grier is the Western representative of the Bryant Electric Company, and that company has bought outright the patents, machinery and business of both H.T. Paiste and W.B. Cleveland, thus placing it in the front rank as a manufacturer of switches.

Mr. T. J. Murphy, 136 Liberty street, New York City, has taken a contract to supply a double switchboard for the new *Herald* Building. The boards will be 7 feet 6 inches high, 12 feet long, and made in six sections. They will be mounted on iron frames raised 2 feet from the floor, with connecting braces across the top. The boards will be of marbleized slate, Egyptian finish, and all instruments to be mounted directly upon the boards. Mr. Murphy has also recently completed a board in imitation of Mexican onyx for the private residence of G. P. Morosini, at Riverdale, N. Y., in which all holes were drilled after the board was finished without injury. This was done by putting a patent preparation over the board which, when dry, was as hard as the slate itself, but of such a nature as not to impair the most delicate finish.

Vulcanized Mud.—The Delaware Hard Fibre Company, of Wilmington, Del., has just issued a card calling the attention of electrical manufacturers to the fact that the low prices which prevail for fibre have tempted some manufacturers of that material to introduce impurities in their goods. It states that this can be done in the same way that rubber goods are adulterated. In samples it has recently examined it found large percentages of red clay and chloride of zinc and calcium. In one case nearly 50 per cent. by weight of the "fibre" was composed of these impurities. The presence of such ingredients makes the fibre brittle, easily split and causes it to swell and shrink under atmospheric changes, besides utterly destroying its insulating properties. Such material is wholly unfit for electrical work. This "mud fibre" can be sold for from one-half (depending upon the available supply of clay) to one-quarter of the price of the genuine article.

The Portneuf Electric Light and Power Company, Pocatello, Idaho, recently put in a 54-inch new American turbine and complete outfit of gearing, shafting, pulleys, etc., furnished by the Dayton Globe Iron Works Company, of Dayton, O. The Dayton Globe Iron Works Company has received the following orders: One 66-inch and seven 12-inch special new American turbines from the Moosehead Pulp and Paper Company, of Solon, Me.; one 30-inch wheel from Cobb & Dree, of Plymouth, Mass.; one 13-inch wheel from Paper Manufacturing Company, Saltillo, Mexico; one 36 inch wheel from Schoellkopf & Mathews, of Niagara Falls, N. Y., to work under 50 feet head; one 36-inch wheel from Shenandoah Pulp Company, Harpers Ferry, W. Va.; one 60-inch wheel from David Wadsworth & Son, Auburn, N. Y.; one 48-inch and one 42-inch wheel from Newton & Pride, Tomahawk, Wis.; one 54-inch wheel from Island Power Company, Minneapolis, Minn; two 45-inch wheels from Sohngen & Brown Company, Hamilton, O.; three 54-inch, one 60-inch and one 66-inch wheels, new American turbines, to be shipped to Canada.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filters for sale cheap. Prices on application to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Bedell and Crehore's Alternating Currents.—What is said of it:

"An excellent piece of authorship, embodying a still more excellent piece of research. I congratulate you on the excellent work of the compositor and electrotyper and on the fine appearance of the book. The publishers and their coadjutors deserve great credit for their share of this work."—Prof. R. H. Thurston.

"For those who are interested in the theory of alternating currents, and who are possessed of the requisite elementary mathematical knowledge, the book cannot fail to be useful."—A. E. Kennelly.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

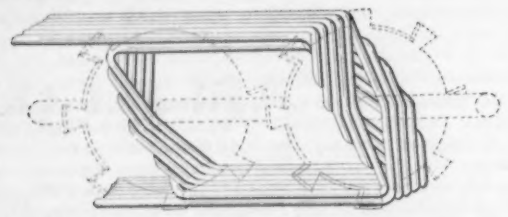
UNITED STATES PATENTS ISSUED MARCH 21, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

493,629. Thermal Cut-Out for Electric Lamps; Herman Lemp and Merle J. Wightman, Hartford, Conn. The combination with an incandescent lamp, of a thermostatic shunting contact having a permanent metallic connection at one point with the leading-in conductor, and a fusible or destructible connection at another point and in proximity to the filament.

493,672. Automatic Electric Cut-Out; Francis B. Badt, Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed June 6, 1889. The combination, with a storage battery and a dynamo electric machine for charging the same, of a high resistance electromagnetic circuit closing device adapted to be operated when the battery is fully charged, a circuit controller and mechanism adapted to open the circuit of the storage battery and dynamo, and to close an engine valve.

493,673. System for Transmitting Electric Currents; Edward Baines, Brooklyn, N. Y., Assignor to himself and Edward J. Mitchell, of same place, and Adolph L. Mitchell, of Rockville, N. Y. Application filed March 21, 1892. In a system for transmitting electric currents the combination of two or more non-insulated line wires in contact with the earth, each supplied with an electric generator, transmitting and receiving instruments on each line, and an insulated metallic return connected to all of the line wires.



No. 494,042.—SYSTEM OF WINDING ARMATURES FOR DYNAMO-ELECTRIC MACHINES.

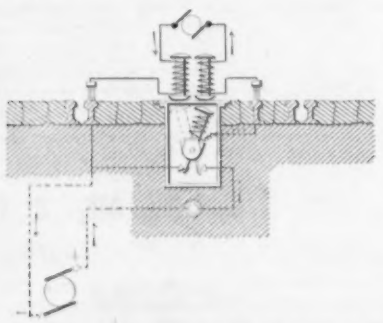
493,678. Electric Railway Signal; Jefferson Bradford and James P. Williams, Boston Station, Ky. Application filed June 23, 1892. The combination, with the track rails of the transverse rods connected to the rails and beneath the same, and formed with oppositely extending hooked extensions, insulators on the horizontal portions of said extensions and the two line wires on said insulators.

493,679. Dynamo-Electric Machine and Motor; Harold P. Brown, New York, N. Y. Application filed Dec. 10, 1891. In a dynamo-electric machine, a toothed armature with coils composed of flat conducting tape insulated with a tape of insulating material capable of withstanding moisture and of resisting a high degree of heat, composed of asbestos paper or its equivalent, coated or impregnated with burned shellac.

493,695. Conduit Electric Railway; Henry P. Feltrow, Columbus, O., Assignor of one-half to Richmond R. Brown, of same place. Application filed March 4, 1891. In an electric railway, the combination of a conduit arranged between the track rails and having its sides and bottom formed of insulating material, cross-pieces arranged transversely in the conduit and having upper insulated faces, the motor car, a central trolley wheel suspended beneath the car and in circuit with its motor, opposite depressing wheels suspended beneath the car near each end and in close proximity to the conduit and a flexible conductor resting on its insulated cross-pieces in the conduit and adapted to be lifted out of the conduit on to the trolley wheel and to bear under said opposite depressing wheels.

493,704. Listening and Ringing Key for Telephone Switchboards; William M. Goodridge, Highland Park, Assignor to the Western Electric Company, Chicago, Ill. Application filed July 19, 1890. In a ringing and listening key the combination of the insulating block, the main metallic spring lever, the cam and lever pivoted on the said insulating block, and adapted to force the said spring lever out of contact with a connection to the operator's telephone set, the two terminal metal springs, the contacts therefor provided on the heel of the said main spring lever, the generator strip, the push buttons, said terminal springs adapted to be forced into contact with said generator strip and out of contact with the heel of the said main spring lever by the said push buttons.

493,713. Insulator for Trolley Wires; Merrill H. Hathaway, Springfield, Mass., and John Kelleher, Manchester, N. H., Adele L. Hathaway, Administratrix of said Merrill H. Hathaway, deceased. Application filed April 2, 1892. An insulating hanger for trolley wires consisting of a substantially cup-shaped shell having means whereby it can be suspended from a bracket-arm or other support and having an opening in the bottom thereof, a metallic tube extending upwardly within said shell, a lining of insulating material entirely surrounding said tube within the shell, a metallic stem adapted to enter said tube and having at its lower end means whereby it can be rigidly secured to a trolley wire, and means substantially as described for securing said stem in position within said tube.



No. 493,948.—CLOSED CONDUIT FOR ELECTRIC RAILWAYS.

93,716. Conduit System for Electric Railways; Elias Hazelton, Lansing, Mich. Application filed February 15, 1892. In an electrical system of street car propulsion, an underground conduit, a main line electrical conductor, casings engaged in the wall of the conduit through which electrical contact is made with said conductor, and a contact device engaged with said casing for making its electrical contact with the conductor, each of said casings provided with a cap engaged over said conductor.

493,718. Dynamo-Electric Machine; Santa Hellebrandt, Przemysl, Austria Hungary. Application filed May 25, 1892. In a dynamo the combination with the frame, the shaft, and the two commutators, of a series of electromagnets arranged spirally on said shaft, a series of field magnets secured to the frame and provided with upwardly extending field magnet poles, a series of brushes operating on each of said commutators and adapted to be adjusted by means of screws and in series, by means of slotted plates, to which they are secured, a pinion secured to the shaft and a spring motor operating said pinion.

493,723. Dental Appliance for Obtunding Nerves; William P. Horton, Mt. Cleveland, O. Application filed Aug. 18, 1892. The combination with the standard or support, rotatable shaft and burr of a dental engine, of an arm within which said shaft is journaled, a rotatable contact point on the end of said shaft, a non-rotatable arm serving as the other contact point, and an electricity producing apparatus, one pole of which is connected with said non-rotatable arm, and an electrode connected with the other pole of said battery.

493,739. Electric Arc Lamp; Elihu Thomson, Lynn, Mass. Application filed June 30, 1886. The combination of an electric arc lamp, of an electromagnet, a feed mechanism operated thereby, a switch contact governed by the magnet for throwing the same into and out of action so as to produce a reciprocating movement of the parts, and a consequent step by step feed and a closed circuit conducting band or envelope for said magnet.

493,745. Dynamo-Electric Machine; Forée Bain, Chicago, Ill. Application filed Dec. 21, 1891. An armature frame for dynamo electric machines consisting of a supporting shaft and a series of primarily dish-shaped plates placed on such shaft, and flattened thereon to cause them to grip the shaft, said shaft treated with a saline or similar substance prior to the application of such plates.

493,754. Electric Connector and Cut-Out; Charles H. Crockett and Chancellor C. Allen, Boston, Mass. Application filed April 8, 1892. The combination of a base portion provided with a wire clamp with the fastening arm or link provided with an opening through which a portion of the wire clamp passes on which said link is pivotally movable, and the cap portion provided with a fastening arm adapted to be engaged with and disengaged from the said link by the pivotal movement thereof.

493,755. Electric Cut-Out; Charles H. Crockett and Chancellor C. Allen, Boston, Mass. Application filed April 8, 1889. The coupling members provided with a seat recess and a spring opposite thereto, combined with the co-operating coupling member having a shank and offset inclined thereto, co-operating with said seat and spring as described, said coupling being engaged and disengaged by a rocking or pivotal movement of one member relative to the other.

493,777. Electric Clock Striking Mechanism; William Kaisling, Allegheny, Pa. Application filed April 4, 1892. The combination with the centre shaft of a clock carrying a series of contacts, or a stationary series of contacts adapted to contact electrically therewith during the revolution thereof, a second annular series of stationary contacts electrically connected to the last-named series of stationary contacts, a contact arm arranged within said annular series and adapted to contact electrically therewith during its revolution, a normally open electric circuit, including a generator and signal, of which circuit each of the respective stationary and moving contacts and said contact arm form terminals, a spring connected with said contact arm and adapted to rotate the same, a detent for holding said contact arm against rotation, and means for disengaging said detent, whereby said circuit is closed and the signal operated.

493,789. Trolley for Electric Railways; John F. Saitz, Baldwin, Pa. Application filed June 18, 1891. In trolleys for electric cars or like conveyances the combination of a trolley frame, two grooved wheels mounted therein, a draft bar connected to the trolley frame between said wheels and a weight hung loosely from said draft bar to balance the trolley frame.

493,817. Secondary Battery; Lars Bristol, London, Eng. Application filed Aug. 28, 1890. In a secondary battery, plates composed of an active agent and a fibrous binding material, conductors embedded therein, said conductors being of dovetail shape in cross section.

493,858. Transmission of Power; Thomas A. Edison, Llewellyn Park, N. J. Application filed Aug. 28, 1890. The combination with a pulley or wheel provided with one or more circumferential windings, and having exposed circumferential surfaces of opposite polarity at the sides of the windings, of an endless belt passing over the said pulley or wheel, and armatures or keepers closing the magnetic circuits around the winding or windings and acting to increase the adhesion between the pulley or wheel, and the belt. (See illustration.)

493,868. Switch for Electric Light Fixtures; Joseph Hutchinson, New York, N. Y. Application filed April 8, 1892. The combination in a switch of a strap having beads or flanges at its ends, an insulating plate or block carried by said strap, contacts carried thereby, and a movable switch member engaging said beads or flanges and adapted to turn thereon.

493,883. Insulating Coupling; Ernest Ballet, Bordeaux, France. Application filed Oct. 31, 1892. An insulating pipe coupling consisting of the internally screw-threaded tubular cylinder having a head which is recessed on top around its central bore, an insulating cylinder, surrounding cylinder, recessed internally in its upper end to receive and support the said head and having an external annular shoulder, the lower shell section having an internal shoulder for supporting said annular external shoulder, an insulating cylinder which rests on the said head and is provided with a downward extension that fits into the recess thereof, and the upper shell provided with a recess for receiving an extension on the upper end of the last named cylinder, the said upper shell being screw-threaded for coupling with a pipe, the two sections having screw-threaded engagement together for tightening or loosening, and the bores of the parts being continuous.

493,884. Rosette Cut-Out; Charles Edward Barry, New York, N. Y. Application filed Aug. 16, 1892. In a rosette cut-out, the combination of a base having a pair of contacts, a cap or cover having a notched flange constituting, in connection with the contacts, a bayonet joint, by which the cover is secured to the base, and several pairs of contacts located in said cap and provided with fuses connected to the lamp wires and adapted to be brought successively into circuit.

493,907. Telephone; Charles T. Bloomer, New York, N. Y. Application filed Nov. 28, 1892. In a signal box a movable rod with a transmitter suitably supported, a fender therefor, and a hook to support the receiver, and circuit contacts, all positioned by movements of the rod.

493,914. Converter System for Railways; Alard Du Bois-Reymond, Charlottenburg, Germany. Application filed Feb. 3, 1892. In an electric railway system, the combination with a plurality of transformers, of sectional working conductors connected to the secondaries of said transformers, and a circuit-closing device in said secondary conductors, adapted to short circuit said secondary conductors when no current is required in the sections of the working conductors to which they are connected.

493,918. Electrically Operated Railway-Switch; Powell Evans, Philadelphia, Pa. Application filed Dec. 7, 1891. In an apparatus for the control of a switch, in combination with switch operative mechanism contained in closed casing, as a means for communicating the regulated movement of the operated mechanism to the switch, a rigid shaft bar or pitman passing through and suitably packed with respect to the wall of the said casing.

493,926. Lightning-Arrester; Hermann Otto Henneberg, Berlin, Germany. Application filed Dec. 9, 1892. In a lightning arrester for electrical conductors, the combination of a discharge plate and an inner cover relatively separated, the latter having its upper face convexed to form a watershed, and an outer cover bearing on the central portion of said upper face and forming a moisture conducting chamber.

493,935. Electric Railway-Signal; Henry V. Miller, Bloomington, and Alexander C. Miller, Aurora, Ill. Application filed Nov. 8, 1892. In an electric signal, the combination of a third rail divided into blocks or sections of any desired length, magnets connected with each end of such section and with a suitable contact post, contact posts adjacent to such magnets and connected with similar magnets forming part of the adjacent blocks, and vibrating arms placed between such posts and connected with the ground, and all arranged and operating.

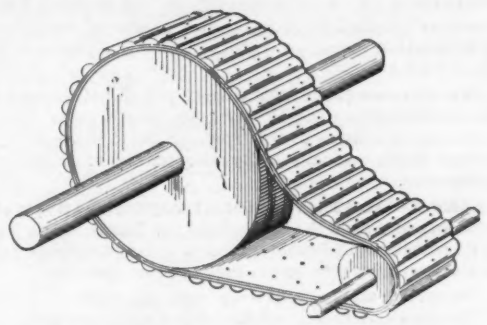
493,942. Electric Locomotive; Alexander Philipsborn, Berlin, Germany. Application filed April 21, 1892. The combination in an electromotor car with the traction wheels and axle thereof, of a motor provided with a tubular armature shaft concentric with said axle, suitable means for transmitting motion therefrom to the traction wheels, a truck frame supporting said motor and capable of a limited oscillatory motion relative to the axle, and body sills elastically connected to said frame.

493,943. Electric Locomotive; Alexander Philipsborn, Berlin, Germany. Application filed May 17, 1892. The combination in an electro-locomotive of a motor-supporting frame connected at the rear with rigid bearings in which turns the rear axle and having a free swinging connection with the front axle, shouldered standards mounted on said supporting frame, a motor sustained by said standards, and springs interposed between the shoulders of the latter and the motor.

493,948. Closed Conduit for Electric Railways; Georg Wilhelm Von Siemens, Berlin, Germany. Application filed June 24, 1892. In an electric railway system, the combination with a track or way and the successive conductor sections insulated from each other, of a permanently located electromagnetic switch for each section to successively cut the same into and out of circuit, a vehicle carrying electromagnets located in different longitudinal planes, the coils of which are successively in series with those of the electromagnetic switch devices, and contact-making devices carried by the vehicle. (See illustration.)

493,969. Electric Car; Charles Brown, Basle, Switzerland. Application filed March 8, 1892. The combination with a driving wheel provided with an outer part or rim made separate from the body of the wheel, of a motor for actuating the same, the revolving part of which is attached to the body of the wheel, and a spring or cushion interposed between the outer part or rim and the body of the wheel.

493,997. Electrical Attachment for Rocking Chairs; Charles E. Hartelius, Bay Ridge, N. Y. Application filed Nov. 22, 1892. The combination, with a rocking chair, of electrodes or contacts carried by the chair, a dynamo arranged in circuit with said electrodes or contacts and mechanisms actuated by the movements of the chair for operating the dynamo.



No. 493,858.—TRANSMISSION OF POWER.

494,007. Block-Signal System; John La Burt, New York, N. Y. Application filed June 16, 1892. In a block signal system, the combination with the track, contact rails having electrical connections controlled by the operations of an adjacent semaphore, a locomotive, an engine carried by the locomotive and operatively connected with the locomotive's shut-off lever, an electric motor carried by the locomotive and adapted to control the engine valve, and an electrically controlled circuit closer adapted to hold the motor in circuit till the engine is operated and then to break the motor circuit.

494,042. System of Winding Armatures for Dynamo-Electric Machines; William M. Thoms, Grand Rapids, Mich. Application filed Jan. 29, 1892. The method of winding drum armatures for electric machines, which consists in passing all wires in a convolution to one side of the armature shaft and then extending them across the end of the armature by means of a flat twist in the ribbon. (See illustration.)

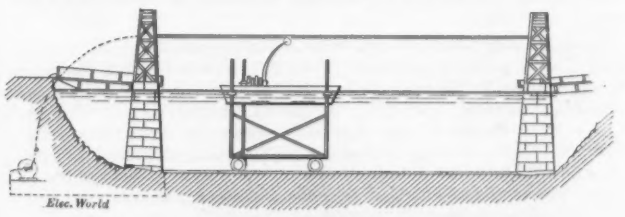
494,053. Reciprocating Electric Drill; William A'Court Glanville Birkin, Nottingham, England. Application filed April 23, 1892. The combination of the shell or jacket composed of soft iron end sections and a central non-magnetizable section, a series of solenoids inclosed in said shell, the soft iron core attached to one end of the shell and projecting into the hollow of the adjacent solenoid, the plunger inclosed by the solenoids and provided with a rod or stem that projects longitudinally through the core and carries a tool stock, the commutator, and electrical connections with the solenoids.

494,062. Secondary Battery Electrode; William W. Donaldson and Roderick Macrae, Baltimore, Md. Application filed March 4 1892. A battery plate made up of sections each with a diaphragm and united together with their diaphragms in juxtaposition.

494,066 Marine Railway; Edward Kaye, Phillipsburg, Pa. Application filed Dec. 9, 1892. In a marine railway, the combination of a submarine car, a floating vessel connected to said car, an electric motor on the vessel, and means for communicating motion from the motor to the driving axle of the car, with a stationary electric generator and electric connections between the generator and motor. (See illustration.)

494,077. Railway Block Signal; Robert D. Peters, Winamac, Ind. Application filed July 11, 1892. An indicator for indicating the position of a train on a railway system consisting of a casing, indicator marks, an indicator hand therein, a magnet at each indicator mark, each magnet being electrically connected to a device alongside the track which a passing train will operate to throw said magnet into an electrical circuit.

494,091. Electric Cigar Lighter; William M. Thomas, Chicago, Ill. Application filed Oct. 26, 1892. In an electric cigar lighter, a tubular handle, in combination with a contact point mounted therein, the elastic lever mounted in an insulating plug and arranged to stand normally in a plane inclined from the contact point, the insulating button provided with slot, the pin passing through said slot and electric conductors connecting said handle and lever, respectively, with the spark coil.



No. 494,066.—MARINE RAILWAY.

494,098. Electrical Appliance; Charles H. Folger, Cincinnati, O. Application filed Sept. 5, 1892. The combination with the two axial solenoids wound in the same direction of the rod or plunger common to both solenoids, stops to limit the throw of the rod in both directions, the groove in said rod, switch pivoted upon a suitable support and contact surfaces, each in electrical connection with the coil of its respective solenoid, said switch being in electrical connection with one pole of the circuit, while the solenoid coils are both in connection with the other pole, whereby the reciprocation of the rod will shift the current from one solenoid to the other.

494,111. Electrical Railway Signal; Samuel W. Miller and Alexander C. Miller, Aurora, and Henry V. Miller, Bloomington, Ill. Application filed April 4, 1892. A railway signal comprising a magnet connected with the ground and with a suitable source of electricity, a pair of contact posts adjacent thereto, a white light connected with one of such posts, and a red light connected with the other, both lights being in an independent circuit, and a vibrating arm placed between the posts and normally held in contact with the one connected with the white light, and means whereby, when the current, passing through the magnet is increased the arm will be withdrawn from the white light post and brought into contact with the post connected with the red light, thereby extinguishing the white light and lighting the red one.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.